Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA.

VOL. XXXVI. No. 13. NEW YORK, WEDNESDAY, MARCH 28, 1900. ISSUED WEEKLY.

Electrical Review

TIMES BUILDING, 41 PARK ROW,
P. O. BOX 2339. NEW YORK.

CHARLES W. PRICE, - - - - - EDITOR.
STEPHEN L. COLES, - - MANAGING EDITOR.
CHARLES T. CHILD, - - TECHNICAL EDITOR.
STEPHEN H. GODDARD, - - ADVERTISING MANAGER.
RUSSELL HOWLAND, ASS'T ADVERTISING MANAGER.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," - - - - NEW YORK.

TELEPHONE CALL, 1546 "CORTLANDT."

WESTERN OFFICE:
FRANK E. COLBERT, REPRESENTATIVE,
955 Old Colony Building, Chicago.

WASHINGTON OFFICE:
GEO. C. MAYNARD, - - REPRESENTATIVE,
Room 102. Washington Loan and Trust Building,
WASHINGTON, D. C.

LONDON OFFICE:
HENRY W. HALL, - REPRESENTATIVE,
42 Old Broad Street, LONDON, E. C.
News, Subscriptions and Advertisements.

Subscription to the
ELECTRICAL REVIEW.

One Year, United States and Canada, - - $3.00
One Year, Foreign Countries, - - - 5.00
Single Copies, each - - - - - - - - .10
Copies can be supplied for only one year back, at 25 cents each.

Table of Contents, page 330.
Advertisers' Index, page 14

The beginning of work on the underground railroad in New York city, last Saturday, marks the inauguration of the most important electric railway project ever undertaken. It was an occasion for sincere congratulation, not only to the city of New York, but to the electrical profession as well.

We notice a new crop of copper mining companies announcing themselves in the advertising columns of the daily press. We also notice that most of them offer their stock at a heavy discount from par and that they need the money for "further development." Electrical people who may be tempted to indulge in a "flyer" in copper mines are invited to consult their brethren in Boston where some curious things in the copper stock market happened only a few months ago.

THE ELECTROMOBILE.

It is interesting to look back and trace to some degree the history of the automobile vehicle. It appears that the first one was constructed by that semi-mythical engineer, Hero, of Alexandria, somewhere about three hundred years, B. C. This machine worked by steam and singularly enough used a steam turbine engine. Later experiments were carried on by Sir Isaac Newton and others of his time, all looking to the use of steam as a propulsive agent

The first electromobile seems to have been built by Professor Page, who operated a car driven by an electric motor and a primary battery on the Baltimore & Ohio Railroad, in the early thirties. Professor Moses G. Farmer also built a similar arrangement about the same time.

The invention of the electric railway and that of the storage battery coming close together revived interest in projects for automobile propulsion by electric means. The idea of applying the accumulator to tram cars seems to have been almost simultaneously exploited in various parts of the world, and as early as 1886 successful cars of this type had been operated. It was some time after that year before experiments were inaugurated using vehicles traveling on the surface of the roadway and not on rails.

The early types of storage battery were not satisfactory for automobile purposes or for use on street railway cars. There was, therefore, an interval of many years during which interest in self-contained and self-propelling vehicles lapsed.

About five years ago, however, interest in automobilism again revived, this being especially true in France and certain other European countries. The half-forgotten and much-berated electric automobile vehicle was again taken in hand, this time by engineers of competent ability working with materials and apparatus better than ever before, and the result has been the extraordinary development of the electromobile as we know it to-day.

France did not long retain her prestige in the design and construction of electromobiles. Her inventors and engineers seemed to have pinned their faith to a greater degree upon automobile vehicles using other types of prime motive power. In the United States, however, it came to be recognized as an axiom that nothing else was suitable as an automobile power so long as electricity could be used for that purpose. The public familiarity with trolley cars and electric lights caused a general understanding of the satisfactoriness of electric motors which is not widespread in any other country in the world. In fact, the American public may be said to be well and favorably acquainted with the electric motor and in contrast to it the ill-smelling and noisy explosion engine and steam motor apparatus suffered greatly.

Perhaps on this account the major effort of American designers has been for the perfection of electrical types of automobiles. How great that perfection now is, is perhaps best shown by the fact that in New York city alone a public cab service using electromobile cabs has grown up and kept in continuous operation through all sorts of weather for three years, during which time the number of its vehicles in service has quadrupled, and that it can not now obtain cabs from the manufacturer rapidly enough for its growing demands. This practical fact is sufficient answer to the cavilings of those who, for one reason or another, have opposed the development of the electromobile.

With experience in construction and operation and under the stimulus of an ever-increasing demand on the part of the public for such machines the electric automobile has been vastly improved in the few years that comprise its actual history. It is to-day not only the most modern but certainly one of the most in-

teresting products of electrical engineering skill In no other department of their profession have engineers shown greater ingenuity in adapting the materials and means at hand to the desired end. In succeeding pages of this issue of the ELECTRICAL REVIEW will be found descriptions of the modern types of electromobiles made in the United States. Whether or not one is interested in automobilism or in the structure of the automobile itself he can not fail to be interested in the extraordinary development of a new industry which these pages exhibit.

CONCERNING ELECTROMOBILE CONSTRUCTION.

It seems time for an urgent plea to be made for some style of electromobile vehicle that will proclaim what the thing is and not let it go around forlornly as if it were an ordinary vehicle seeking the departed spirit of its horse. It is unfortunately true that conservatism has been too evident in designs of automobile vehicles so far. They still look much more like horse vehicles than they do like anything else, and the noticeable absence of the horse is disturbing to our unaccustomed eyes. It may be that when the horse has passed into tradition such types of vehicles, if they still remain with us, will not look as if some essential element were missing, but will seem as complete to us as the stylish carriage of to-day does with its horses in front of it.

Seriously speaking, it is time for some real artist to make a design that shall embody together with grace and beauty of line all of the conveniences that the horseless structure is capable of, and not in any degree suggest the ancient hippomobile as its predecessor. Among many of the conveniences which are possible in the new style the following may be mentioned as typical: Access by a door in front of the machine instead of by the inconvenient side doors now in vogue and necessitated by the fact that the horse is in front of the ordinary vehicle; lower steps and bodies, made possible by the smaller wheels which can be used with the automobile to the great convenience of the feminine half of the population; open fronts of clear glass for enclosed types of vehicles so that the occupant can look directly ahead at the street and the passing scene without having to crane his neck sideways as in the common cab on the streets to-day. These are merely a few of the many great improvements looking to the comfort of the occupant that could be secured by abolishing once and for all any semblance in the electromobile to the design in vogue for horse vehicles.

Still, we are creatures of custom and convention. It took a mighty effort to rid the steam railway car of its semblance to the stage coach of former days. Men still go around with buttons on the backs of their coats to fasten up their skirts while riding, and they wear buttons on their sleeves to fasten back their cuffs while defending themselves with the sword, although horseback riding as a means of transit and sword-play as a means of defense have disappeared from the face of the earth. So it may be that some antiquarian in the dim future will grope back to to-day and trace in the railings which still survive on top of the flying machine of that date the guards upon which the reins of the extinct horse were rested. Still, it is worth while trying to get a new and modern design. The ELECTRICAL REVIEW would be glad to hear from its readers on this subject and if sufficiently meritorious designs are suggested, to publish them.

A RECORD IN EXPORT TRADE.

The month of February, 1900, showed a total of more than 25 per cent larger export business than has been shown by any preceding February in the history of the country's foreign commerce. Not only is it true that the exports themselves, valued at $119,765,762, are greater than in any preceding February, but the excess of these over imports for the same period is larger than ever before and surpasses that of 1898 by twenty-five per cent.

From figures compiled by bureaus in Washington it appears that the total exportation for the eight months ending with February was $75,000,000 greater than that for the corresponding months of the last fiscal year. It is thought that this fiscal year, ending June 30 next, will make the remarkable showing of a commerce valued at more than $2,000,000,000.

It was not many years ago that electrolytic copper appeared upon the market. To-day it is more important than Lake copper since the transactions in it are larger and it has become practically the standard metal. Our well-informed contemporary, the *Engineering and Mining Journal,* has concluded to give hereafter the quotations on the electrolytic metal as the standard of average values and put in a subordinate place quotations on Lake copper.

The significance of this change in the relative position of the two varieties of the red metal is one of peculiar interest to the electrician. Electrolytic copper is as much a product of the electric arts as calcium carbide or aluminum. It has already shown that it is a more desirable metal for many purposes, while it is acceptable for nearly all. At the same time the Lake copper has become less pure as the mines increase in depth and also because of the closer concentration of the ores practiced nowadays since the enhancement in value of the product. Few people appreciate the vast industrial importance of electrolytic processes and the fact that in a few years the electrical method of refining copper should have worked to some degree a revolution in the great industry of the production of that metal, speaks in no uncertain terms for the growing value of methods in which electricity plays the principal part.

AUTOMOBILE STEALING.

A horse thief was sent to Sing Sing yesterday. It is a curious fact that the automobile thief has not yet put in an appearance.—*New York Evening Sun.*

Reasons: 1. Nearly all automobiles are made "thief-proof" by removing a little controller device which may be carried in the pocket of the owner. 2. Not being familiar with the operation of an automobile, a thief would as likely as not run himself into a police station.

The only really successful way to steal an automobile left alone by its owner is to load it on a horse truck and drive away with it. This should not be difficult when it is remembered that not long ago a New York thief got away with a 70-foot iron smokestack and has not yet been caught.

POWER CONSUMPTION AND OPERATIVE COSTS OF AUTOMOBILE DELIVERY WAGONS.

A STUDY OF THE COMPARATIVE COSTS OF OPERATION AND MAINTENANCE OF HORSE AND ELECTRIC DELIVERY WAGONS FOR CITY SERVICE.

BY PROFESSOR GEORGE F. SEVER.

The purpose of this article is to present a brief resume of the data and results obtained in the early part of 1899 while investigating the operative costs of electric and horse delivery service in New York city.

In the paper on "Operating Costs of Horse and Electric Delivery Wagons in New York City," by R. A. Fliess and the writer, presented at the general meeting of the American Institute of Electrical Engineers, at Boston, in June, 1899, a very careful analysis was given of the actual costs of operation of the two methods of service under city conditions. Up to that time there was available little information of an authorative nature on the cost of horse operation and therefore this information obtained from business houses with large delivery services provided a basis of comparison which is valuable. More recent figures obtained from other business houses using horse service corroborate the data on this service, so that we can accept these figures as a recognized standard.

From the data on horse operation the cost of maintaining such service was found to be as follows: Total cost of 1 wagon, 1 horse, wages and attendance per day equals 364.83 cents, of which 64.61 cents or 17.7 per cent is chargeable to the horse, 14.52 cents or 3.98 per cent is chargeable to the wagon, and 285.7 cents or 78.32 per cent is required for the wages of the driver and his helper.

The total weight to be moved is 2,075 pounds or approximately one ton, 500 pounds of this being considered the weight of the load to be delivered. In this service each wagon covers 21 miles per day, so that the cost per ton-mile, which is the unit of comparison, would be $364.83 \div 21 = 17.373$ cents.

In the case of a wagon covering twice the distance of the first, *i. e.*, 42 miles per day, there will be needed two horses and therefore an additional expense for those items as is shown by the following figures: Total cost of 1 wagon, 2 horses, wages and attendance per day equals 428.54 cents, of which 128.32 cents or 29.9 per cent is chargeable to the horse, 14.52 cents or 3.3 per cent is chargeable to the wagon, and 285.70 cents or 66.8 per cent is chargeable to the wages of the driver and his helper. The cost per ton-mile will be $428.54 \div 42 = 10.2$ cents in considering the cost per pound of load per mile; under these two conditions we find that, in the first instance, with a total load of 800 pounds and an average of 500 pounds, this cost is $364.83 \div 800 = 0.456$ cents per pound and $364.83 \div (500 \times 21) = 0.0347$ cents per pound per mile.

In the second case with more load delivered, a longer distance covered and requiring more equipment, we find the cost per pound with three loads of 800 pounds delivered, $428.54 \div 2{,}400 = 0.17856$ cents, and the cost per pound per mile with an average load per trip of 500 pounds, $428.54 \div (500 \times 42) = 0.0204$ cents.

The conclusion is readily deducted that the latter method of operation is the more economical although involving a larger first cost for equipment. In the second case the wagon is used nearly three times as much as in the first and the employees are used to better advantage, thereby tending to more economical operation.

The tests on the electric automobiles were made for the purpose of ascertaining the actual power required to operate them on the various pavements which exist in New York city streets, the vehicles used for this purpose being those which were to be used in delivery service. The opportunity presented itself to test vehicles of different design and widely differing characteristics, so that from the results could be obtained a general and quite accurate figure for the power consumption necessary for this service. From these tests the power required is found to be 120 watt-hours per ton-mile or 0.156 horse-power-hours per ton-mile.

This value for the power consumption has been borne out by subsequent tests and can be considered a reliable value to use in estimating the average power necessary for operation. It must be remembered, however, that a larger capacity than that which is necessary to provide this 120 watt-hours per ton-mile, is imperatively required to start the vehicle or propel it up a grade. The power to give a rapid start may be from four to six times that which is necessary for operation at a constant speed on a level or that value which represents the average of a run.

The minimum power used in any of the tests made was 81 watt-hours per ton-mile, showing that with careful manipulation and taking advantage of the features of the roadway, the power used may be reduced considerably from the general value of 120 watt-hours per ton-mile.

In order to ascertain the difference between the cost of delivery with horse and that with electric vehicles, the following comparison can be made: An electric wagon at an average speed of nine miles per hour would cover the same distance per day, *i. e.*, 42 miles, as made by the horse wagon in 4.66 hours and the cost for power at 5 cents per kilowatt hour, with a power consumption of 120 watt-hours per ton-mile, would be 71.28 cents. The weight of the wagon complete, with average load of 500 pounds, is 2.263 tons. In this case the cost of power, 71.28 cents, forms 17.6 per cent of the total operating cost, interest on wagon and stable rent, 47.28 cents, forms 11.7 per cent, and wages for driver and helper, 285.70 cents, form 70.7 per cent, the total cost for operating 42 miles being 404.26 cents. As compared with the cost of horse service, there is seen to be a saving of $428.54 - 404.26 = 24.28$ cents per day under the above conditions. The cost per pound of delivery is 0.16844 cents against 0.17816 for the horse, or 0.01012 cents less. The cost per ton-mile is 4.25 cents against 10.2 cents for the horse, or a saving of 5.95 cents.

This figure is of importance for the reason that the ratio of load to be delivered to total weight of wagon is small and every effort should be made to reduce the weight of the wagon in order to reduce the total power cost. If the figures are analyzed somewhat differently from the method indicated above, leaving out the fixed wages for driver and helper in both cases, it is found that the cost of the horse forms 90 per cent of the operating costs in that service, while the cost of power in the electric service is only 60 per cent. The actual cost of operation then becomes 142.84 cents per day for horse and 118.56 cents for electric, showing as before 24.28 cents per day saving in the latter, this being a 17 per cent saving over horse operation. This is unquestionably a more correct method of comparison in the matter of power cost, as the fixed charges are eliminated. At present it is not possible to present any depreciation values, for the reason that the apparatus is too new to afford any. In the electric service these depreciation values should not be large as the motors and running parts are simple and require but little attention. The battery possesses the largest depreciation factor, it being possibly 20 per cent.

In comparing the cost per pound of load per mile it is found that with horse service this is 0.0204 cents and with electric 0.01923 cents, or a saving of .0015 cents.

That the differences shown are not larg-

er is due to the fact that in making the comparisons, the lowest average cost for horse service has been taken and the highest cost for electric service has been placed against this. With cheaper power a further reduction can readily be made in the operative costs and a better showing made for the electric service. It can be pointed out that if the schedule speed of the automobiles can be raised, the wagons can cover much more territory per day and therefore reduce the percentage that the employees wages are of the total. This is a similar condition to that which exists in electric railway operation and many of the same operative details that now control railway work can be successfully applied to electric delivery service. As has been hinted at previously, the attempt should be made to reduce the weight of the automobile for this service in order that the live load may more readily approach the dead load, thereby decreasing the power cost.

Electromobiles as Police Auxiliaries.

A press telegram from Chicago under date of March 19 tells this moving story:

Two housebreakers were discovered working at a window of a house in Rockwell street, at nine o'clock last night, and a neighbor notified the Stock Yards police by telephone. Both the Twentieth and Ninteenth Precinct patrol wagons were out when the call came and Capt. Lavin was in despair over the idea of the burglars escaping, when an electromobile passed the station.

The driver was hailed in a hurry and arrangements were made to turn the cab into a temporary patrol wagon. Accompanied by Detectives Burns and Reily, Captain Lavin jumped into the rig, a fast run was made to Ashland avenue, and there two men with bundles were seen.

The cab gave chase. After a run of six blocks, the thieves were overhauled. They began to fire and punctured the roof and sides of the cab, but without hitting the policemen. These jumped out and captured the men. The entire party went back to the station in the electromobile.

Captain Lavin said: "These electric cabs are all they are cracked up to be, and more, too. It would be a great thing to have electric patrol wagons, and I guarantee that, if the Police Department were supplied with them, crime would decrease 50 per cent. We had a great ride, and, despite the fact that there was too much lead in the atmosphere, I enjoyed the sensation. Besides, we caught two bad men."

OBSERVATIONS ON THE AUTOMOBILE.

BY H. D. EMERSON.

Five years ago the automobile was a commercial reality only in the minds of inventors and engineers. To-day the general public accepts as a fact that self-propelled vehicles can be built to run on our roads which are safe, comfortable, economical and speedy. And that part of the public which has had a taste of the great individual delight, fascination and personal exhilaration of automobiling has inspired widespread interest and desire in the remainder to ride and own automobiles. Once one goes "bubbling" the habit is fixed. The derivation of "bubbling" may be indicated—"automobile," corrupted, becomes "automobubble," hence "bubbling."

There are three principal forms of power offered on the market commercially. The explosion or gasoline motor does not seem to have demonstrated its availability for regular daily road work in this country.

Bicycles, tricycles and extremely light vehicles of similar construction, where pedal power is available for starting and hill climbing, have a certain vogue, but should hardly be classed with the vehicles under consideration. Electricity, except for its cost makes an almost ideal power. It is safe, reliable, noiseless, non-explosive, and its operation is simple and easily understood. Technical knowledge is required only in the stable. Its drawbacks are greater cost, both original and per mile, and limiting range from the necessity of recharging.

Steam was the first power tried for self-propelled vehicles many years ago. But in considering the development of the modern automobile it is the latest candidate for popular favor. It was only when the limitations of gasoline and electricity had been developed that engineers turned again to steam. It is due to modern methods and devices that it is a success to-day.

Accuracy in manufacture, high pressure, ball bearings, liberal use of steel in improved forms and rubber tires are some of the factors which turned the failures of the early part of the century to present successes. The steam vehicle is more reliable than the gasoline, weighs less, and has a much greater range as well as less cost than the electric. It, however, requires more technical knowledge and greater care in operating than the others.

Turning, however, from the power question to the consideration of the vehicle itself, certain lines can be indicated which experience shows it will be necessary to follow to achieve permanent success. Designs departing from the established lines of vehicle construction are a waste of time. Present road vehicles are the result and development of that best and surest method, experience. A vehicle for passenger service has two main requisites, safety and comfort. More comfort than a bicycle and less exertion than walking is demanded of a pleasure or transportation vehicle. Then, too, the wagon should have sufficient weight on the springs to absorb the road shocks in the body. The wheel base should be long and the seats low. A good illustration of the mistake of neglecting these principals is shown by the early design of the most widely-known steam wagon. Its manufacturers have found it necessary to largely increase the weight in later vehicles.

Steering should undoubtedly be by the front wheels. The rear steering is hard to learn and gives the cab a wabbly motion, which at speed is disconcerting and unpleasant. The steering lever should be horizontal and turn with the wheels as a bicycle handle does. The brake should be sufficiently powerful to stop the wagon with power on. An improvement consists in interlocking or so connecting the brake lever with the power or driving lever that when the brake is applied power will be shut off. The power lever should be removable, so that the wagon will be "fool-proof." In fact, all levers, starting, reverse, brake, etc., might all be so arranged that they are "fool-proof," and inquisitive spectators, or careless passengers, or rattled drivers, can do no harm.

Perhaps an electric Victoria, built in Hartford, and an electric runabout, built in New Jersey, more nearly approximate the ideal than any others the writer has seen.

They have well designed running gear with approved steering mechanism, adequate springs, graceful bodies, comfortable seats and are simple of control and practically safe. If they had the range and economy of steam they would be near perfection.

Some of the friends of the horse have taken fright at the idea that the automobile will displace that noble animal entirely. But against this may be put the fact that in England, the other day, a race horse named Flying Fox was sold for $190,000. So far no automobile has brought this price. A noted horseman said recently that the automobile would displace the horse at about the same time that the typewriter would displace the piano.

AMERICAN MADE ELECTROMOBILES FOR 1900.

Perhaps it is safe to say that the newest development in the electrical arts is the electric vehicle. Although its history dates back for 15 years it is only within the last two or three years that this vehicle has definitely taken its place and become familiar to the dwellers in cities as a permanent and significant factor in urban transportation. Its development has been for the most part along three different lines—the pleasure vehicle, the public cab and the business wagon for the delivery of goods from mercantile establishments. It is the purpose of the articles on the succeeding pages to portray the salient features of present day types of American built electromobiles of these three types and to show that this industry, though still in point of age an infant, has attained a sturdiness of growth that is remarkable and that is even surprising to those who have not kept in touch with its astonishing development.

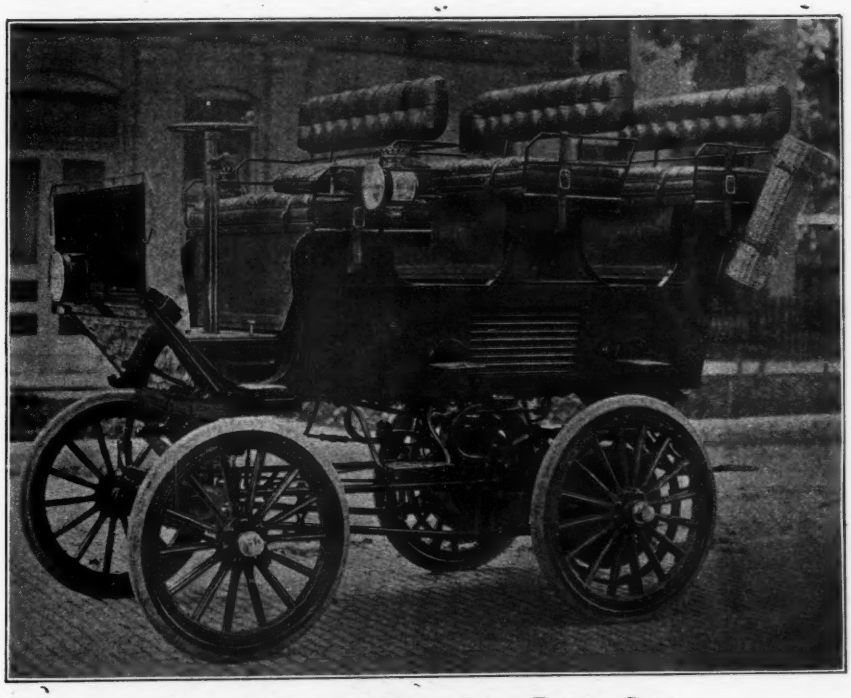


FIG. 1.—A "WAVERLEY" THREE-SEATED ELECTRIC DRAG.

It is generally supposed that European countries, notably France, lead the world in the development and use of automobile vehicles. While this is true to an extent, yet in the United States there has been the highest development and the widest use of the electrical variety of self-propelled carriage, and the peculiar fitness of this machine for urban use makes it likely that no other type will ever displace it for the various purposes of business and pleasure to which it is now applied. While it may be granted that other motive powers may find most successful application on automobiles for general touring and for use in the country, yet nothing can approach the silence, effectiveness, simplicity, ease of control and absence of disagreeable qualities which render the electric motor the most applicable form of power-generating device for such vehicles as are to be used for the most part in cities.

As it is equally incontestable that the automobile found its first, and probably will find its principal use, in city streets, it therefore is purely reasonable to think that for this service the electric vehicle has no peer. Consequently, while acknowledging the important position in the automobile industry occupied by vehicles using steam or internal combustion motors, the ELECTRICAL REVIEW confines itself in this issue to a description of electromobiles—of vehicles for urban use which exhibit those qualities that have already aided in the disappearance of the horse from the streets of our larger towns.

In the construction of electromobiles American manufacturers have already taken the lead. Their vehicles are marked by great simplicity and strength of design and have achieved in the short period that has elapsed since their introduction a success in all senses of the word. It is with peculiar gratification that this brief summary of the newest exemplification of electrical engineering skill is presented, and no one who looks through the succeeding pages can fail to be impressed with the fact that in ingenious design and in the proper adaptation of the means at hand to the end desired, these new products of electrical engineering are worthy of all commendation.

The American Bicycle Company's "Waverley" Electromobiles.

The transition from the manufacture of bicycles to that of electromobiles is not so great a one as many might imagine. Much the same tools are used in making both and a well-equipped bicycle factory, such as that of the Indiana Bicycle Company, makers of the Waverley bicycle, is practically ready to engage in the construction of automobile vehicles. The accompanying illustrations represent a few of the types of electromobiles constructed by the American Bicycle Company's Waverley factory, which is the new title of the company referred to above.

The structural details of these vehicles are largely the same throughout, so that a description of one suffices for all. The frame is made of cold-drawn seamless steel tubing with forged connections, brazed at each joint, the general idea of this type of frame being that of the bicycle, modified to fit the more severe work of the automobile. The front axle is also of tubular construction and is connected with the frame through a horizontal king bolt, so as to permit its free oscillation in a vertical plane, thus securing equalization on uneven surfaces. All the wheels are ball-bearing and are provided with a simple but effective arrangement for direct oiling. The preferred type of wheels is the wooden spoke variety, having solid rubber tires, these seeming to be superior to any other variety of wheel for electromobile purposes. A single motor is used, of the multipolar ironclad type, which is self-lubricating and dust-proof and is constructed for a large overload capacity. It is connected with the rear wheels through single-reduction gearing, enclosed in dust-proof cases, and has compensating gears on the armature shaft, inside of the motor casing, permitting independent action of the two rear wheels. As in most types of American electromobiles, steering is effected through the front wheels and the motive power is applied to the rear wheels.

A special form of spiral tooth gear is used, the pinions being of steel, and it is claimed by the makers that this arrange-

ment insures not only great durability but absence of the disagreeable roaring noise caused when worn gear is forced to transmit large powers. The control gear consists of a single lever which is used for the regulation of both the speed and direction of the vehicle. Steering is accomplished by a lever moving in a horizontal plane and convenient to the operators' right hand; it acts through ball-bearing mechanism. This lever being hinged near the base of the dashboard may be lifted up out of the way so as to render access to the vehicle exceedingly easy. The wheels possess sufficient swing to enable the vehicle to execute a complete turn in twice its own length.

The brake consists of a band applied to a drum on the armature shaft inside the motor casing by means of a foot lever. A rachet device of simple construction allows the operator to lock the brake when it is desired to leave the vehicle standing on an incline. For use in localities where grades are long and steep the makers provide an electric brake which permits the vehicle to descend easily without wearing the shoes of the mechanical brake. The battery used is of a type which the makers claim has shown the most satisfactory results in a period of several years of test under operative conditions.

Referring to the illustrations, Fig. 1 shows a three-seat drag made to accommodate a party of six persons and designed for use in suburbs and on park roads and boulevards. Fig. 2 is a group of different designs comprising a runabout buggy, a physician's buggy having a hood to protect the occupant from the weather, a delivery wagon of standard type and a very neat two-seat golf trap having a wicker-work body.

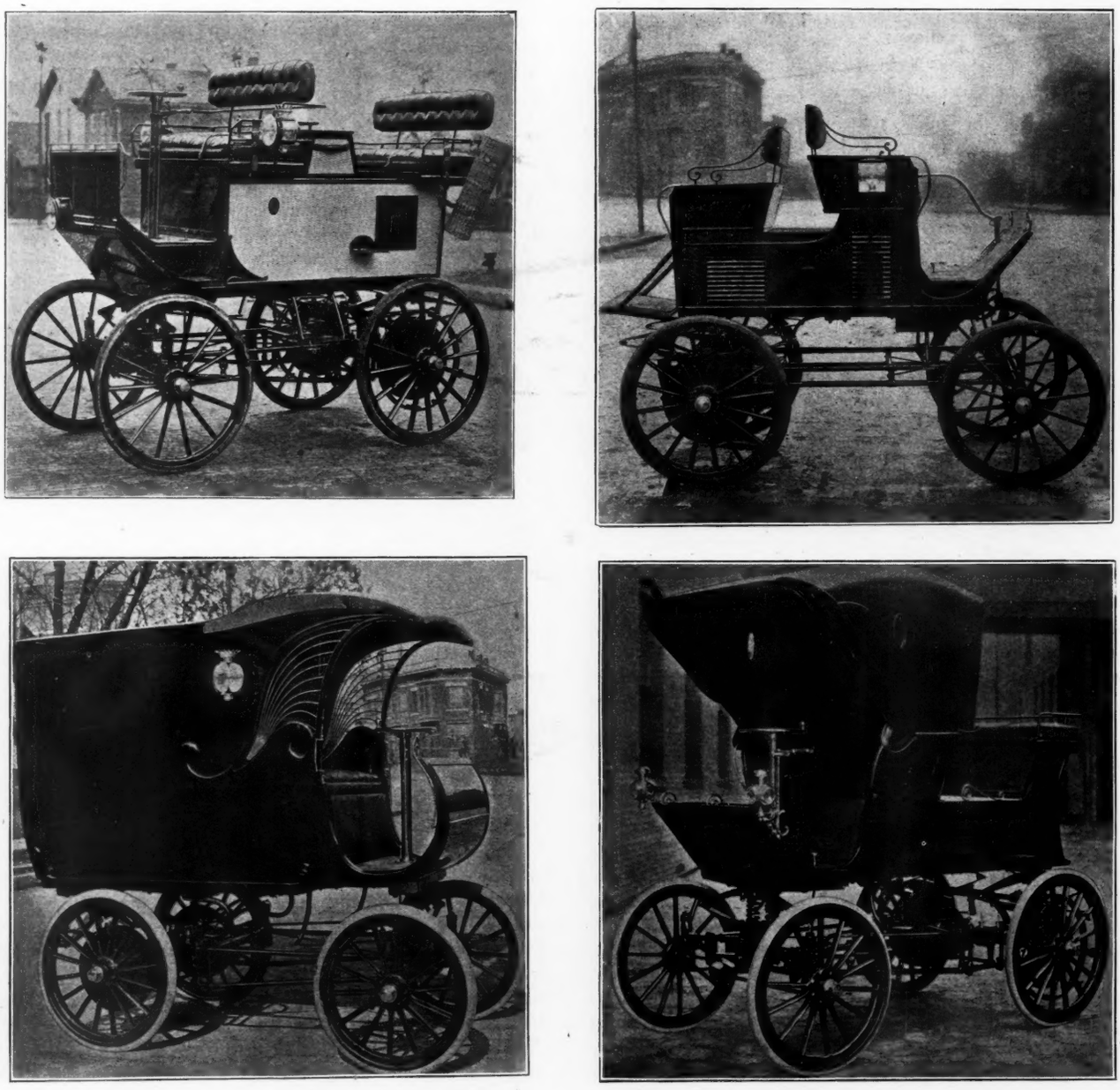


FIG. 2.—"WAVERLEY" ELECTROMOBILES—GOLF TRAP, RUNABOUT, DELIVERY WAGON AND PHYSICIAN'S BUGGY.

It is claimed by the makers that these vehicles will average from 35 to 40 miles per day, according to grades and charging facilities.

This company was one of the first which devoted itself to the production of electromobiles and the illustrations speak better than words for the admirable designs which its elaborate factory equipment is able to produce.

The "American" Electromobiles.

The American Electric Vehicle Company, which has recently established elegant offices, a repository and a charging station at 134 West Thirty-eighth street, near Broadway, New York city, is among the most extensive manufacturers of electromobiles in the United States. The company is operating a large and well-equipped factory at Hoboken, N. J., where numerous types of vehicles are turned out, several examples of which are shown in the illustrations herewith. The company makes its own storage batteries, and one of its runabout buggies has a record of a total run of 61½ miles on one charging of the battery, operating a total weight of 1,500 pounds. The motors used on the "American" vehicles are of the single reduction type with a hollow armature shaft, are compact, dust and waterproof, and are so placed as not to mar the appearance of the carriages. The vehicles can be run to a maximum speed of 15 miles an hour, and powerful band brakes, operated by a foot lever, hold the carriage quickly and firmly on any grade.

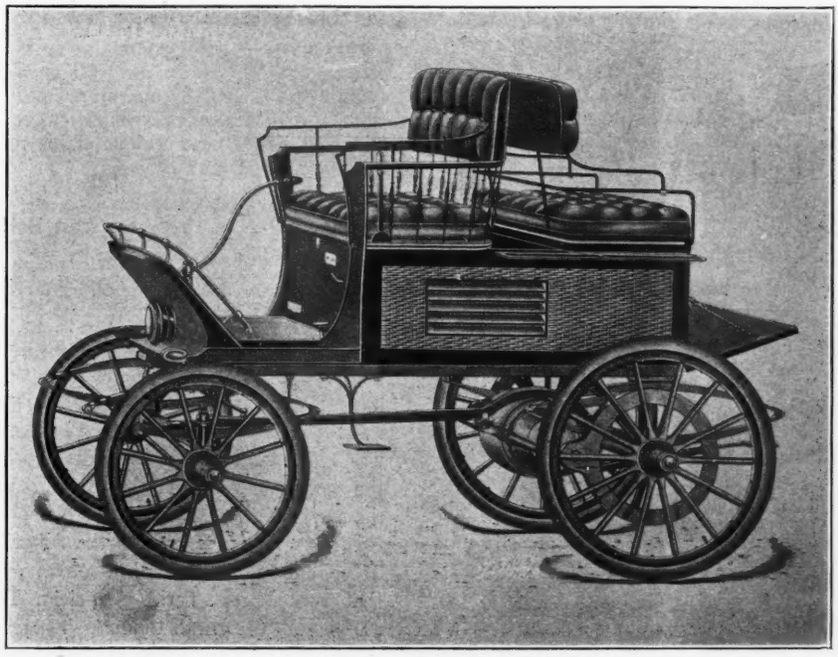


FIG. 1.—"AMERICAN" FOUR-PASSENGER ELECTROMOBILE TRAP.

An exterior view of the company's handsome New York repository, surmounted by an unusually large and brilliant electric sign, is shown in Fig. 4. The "American" pneumatic runabout is shown in Fig. 5. The motor is two and one-half horse-power and has a speed up to 15 miles an hour. The front wheels are 34 inches in diameter and the rear wheels 38 inches. All wheels are equipped with three-inch pneumatic tires.

An "American" pneumatic break is shown in Fig. 3. This is equipped with a four horse-power motor. Its approximate weight is 2,200 pounds, and its maximum speed is about 14 miles per hour. The wheels are the same size as those on the runabout, and are equipped with pneumatic tires.

In Fig. 1 is shown a four-passenger trap, equipped with a 2,400-watt motor and pneumatic tired wheels. This vehicle is of an unusually handsome design and promises to prove very popular with the company's customers. One of the American Electric Vehicle Company's delivery wagons, specially finished, is shown in Fig. 2. The wagon is eight feet long, 44 inches wide and 48 inches high inside. The front wheels are 34 inches in diameter and the rear wheels 36 inches, the whole vehicle weighing approximately 2,500 pounds. The maximum speed obtainable for this vehicle is 12 miles per hour. The American Company makes a specialty of building delivery wagons to suit the special needs of any customer, and is rapidly adding to its list of standard types of vehicles.

The American Electric Vehicle Company shipped last week, to Paris, handsome examples of its electromobile pneumatic break and pneumatic runabout, to be placed on view at the Paris Exposition.

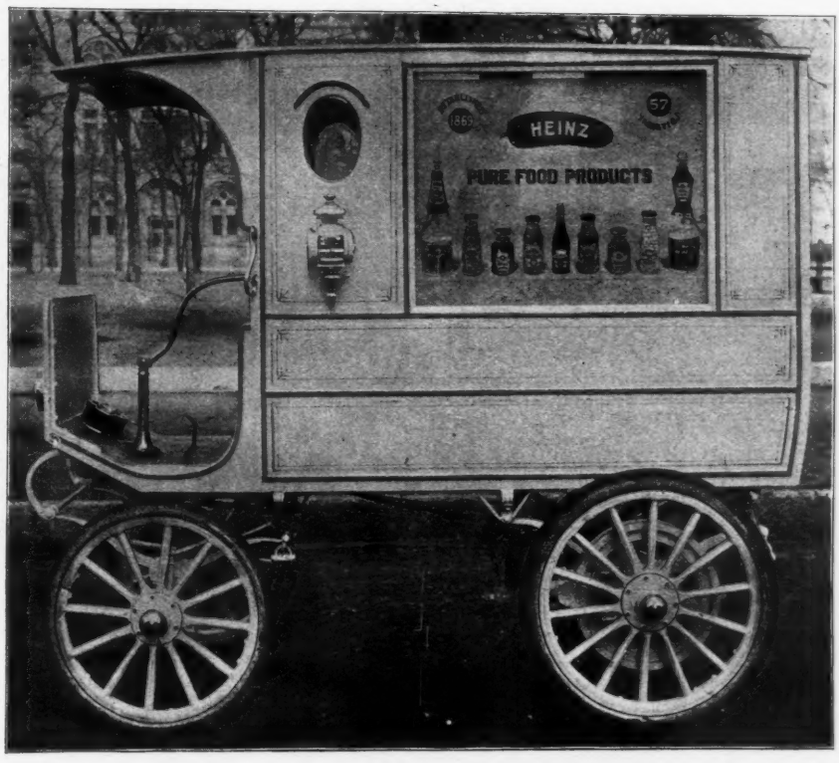


FIG. 2.—"AMERICAN" ELECTROMOBILE DELIVERY WAGON.

No Duty on Automobiles.

In an opinion received by Collector Bidwell, O. L. Spalding, acting-Secretary of the Treasury, rules that an automobile is not free of duty as a personal effect, but is free of duty as a household effect if used abroad by the owner one year or more. The ruling was made regarding an automobile belonging to Mr. J. R. Roosevelt, of New York city, which he desires to take to England for use there for a few months, but later wishes to bring back with him.

A Horseless Stable in New York City.

The "horseless stable" is the natural product of the automobile age. Though many experimenters with the motor-wagon still keep their old vehicles and some of the horses of their former equipment, the real enthusiasts of the automobile movement, who may be described as "devotees," seem to want to get as far away from horses as possible. Very few of them are like Mr. A. C. Bostwick, who runs his automobile wagon away from all the rest of them one day and on the next is found tooling a four-in-hand up to a football game at the Manhattan Field in record-breaking time.

FIG. 3.—"AMERICAN" PNEUMATIC BREAK.

The Automobile Storage and Repair Company, of 57 West Sixty-sixth street, New York city, has made the first provision for the horse-haters that this city has seen and has emphasized the point by adopting the trade-mark, "The Horseless Stable." Its quarters are on the ground floor of the St. Nicholas Rink building, and the 4,000 feet of floor surface devoted to the purposes of this stable contain a very interesting exhibit of what has been accomplished in self-moving wagons. It is a veritable automobile show. Electric, steam and gasoline wagons are all there, and no sight or smell that suggests the horse is ever known. Its popularity, as a means of filling the proverbial "long-felt want," is attested by the fact that while only a few weeks old, the stable has already 25 wagons to take care of. The company was started with an eye to the future only to find that the demands of the present were insistent.

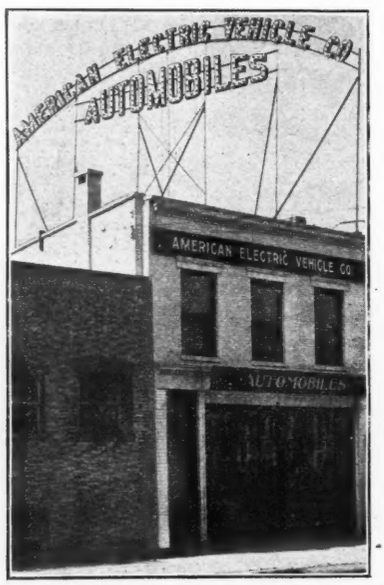


FIG. 4.—AMERICAN ELECTRIC VEHICLE COMPANY'S OFFICES AND REPOSITORY, NEW YORK CITY.

The single recognizable stable feature on the vast floor is the mastic washing stand where the wagons are run to be washed. This and the array of feather dusters and chamois-skins used in the cleaning process furnish the only resemblance to stables elsewhere. The clean and shining carriages on the floor give the place the look of a salesroom, the rheostats and electric meters on the wall have the effect of an electrical laboratory, and the office and waiting rooms would suggest a club. It is the most unique stable proposition in the country.

FIG. 5.—"AMERICAN" PNEUMATIC RUNABOUT.

Absorption of the American Bell Telephone Company,

The annual meeting of the American Bell Telephone Company was held in Boston, on March 27. President Hudson occupied the chair, and about 150 stockholders were present. The annual report was read, and the old board of 13 directors was reelected. The stockholders ratified the recommendation of the directors that the assets of the American Bell Telephone Company be transferred to the American Telephone and Telegraph Company, and that two shares of the American Telephone and Telegraph Company's stock be exchanged for each share of stock held of the American Bell Telephone Company.

Electric Storage Battery Company.

At the annual meeting of the Electric Storage Battery Company, held in Philadelphia last week, the old board of directors was reelected. The company's gross sales for the year ended December 31, 1899, were $2,122,679, against $1,163,584 in 1898. Net earnings on the stock were $924,523 against $299,670 in 1898. These earnings are about six per cent on the present capitalization of the company $16,000,000.

The Electric Vehicle Company's Electromobiles.

The Electric Vehicle Company, of New York city, through its manufacturing department, the Columbia and Electric Vehicle Company, of Hartford, Ct., is probably the largest manufacturer of electromobiles in the United States to-day. The company makes a wide variety of types of pleasure carriages and business vehicles, several of which are shown in the accompanying illustrations. All the vehicles manufactured by this company are equipped with a device of great value by which, when the brake is applied, the controller is thrown out and the supply of current to the motor is completely cut off. The controller must then be brought to the zero point before the vehicle can be started either forward or backward. This is an especially valuable appliance in emergency stops.

FIG. 2—"COLUMBIA" ELECTROMOBILE PHAETON.

FIG. 3—"COLUMBIA" LADIES' SHOPPING VICTORIA.

This vehicle possesses unusual interest as it is the first type made by the old Pope motor carriage department of the Pope Manufacturing Company, at Hartford. It is one of the most successful types designed by the company and is of the original form except for slight changes in detail parts. The phaeton is equipped with three-inch pneumatic tires.

In Fig. 3 is shown a ladies' shopping victoria weighing 1,650 pounds and carrying 650 pounds of battery. This vehicle can be operated for from 20 to 30 miles at 14 miles per hour. It is fitted with three-inch pneumatic tires and can be supplied with or without a victoria hood. A victoria Daumon is illustrated in Fig. 4. The vehicle complete weighs 3,300 pounds and carries 1,100 pounds of battery. It has a running radius of 25 miles at 11 miles per hour.

The latest type of the company's delivery wagon is shown in Fig. 5. This is furnished with the latest equipment of underslung batteries weighing 1,400 pounds, the total weight of the vehicle being 4,000 pounds. It has a running radius of 25 miles at 10 miles per hour. Its normal carrying capacity is 1,000 pounds.

The delivery wagon shown in Fig. 6 is owned by the H. J. Heinz Company. It has been steadily in commission since January, 1899. They have employed it for the delivery of their goods, and incidentally for advertising their product in a number of different cities including New York, Pittsburgh and Buffalo. Its carrying capacity is rated at 1,000 pounds besides the driver and one attendant. This particular vehicle is one of the first delivery wagons which was put out from the Hartford factory of the Columbia and Electric Vehicle Company, and since then the Electric Vehicle Company, who handle the product of the Hartford factory, have sold and delivered over sixty similar wagons. In H. J. Heinz & Company's wagon the battery is carried on the floor of the vehicle and comprises the usual number of cells, 44, which are divided into four groups. Three of these groups are located under the merchandize compartment, the other one being under the driver's seat. The motor is of 40 amperes capacity, spring suspended in front of the rear axle and connected through a single reduction with the rear wheels. It normally develops about three and one-half horse-power, but is capable of delivering 12 horse-power when required.

FIG. 1—"COLUMBIA" ELECTRIC RUNABOUT.

FIG. 4—"COLUMBIA" VICTORIA DAUMON.

In Fig. 1 is shown the company's runabout, which weighs 1,600 pounds and carries a battery of chloride accumulators weighing 650 pounds. This vehicle has a running radius of from 20 to 30 miles at 15 miles per hour. A phaeton is shown in Fig. 2. It weighs 2,500 pounds, carries 1,000 pounds of battery and will travel for 30 miles at 12 miles per hour.

A Storage Battery Decision.

The United States Circuit Court of Appeals, for the First Circuit, consisting of Judges Putnam, Aldrich and Brown, has handed down a decision in the case of the Electric Storage Battery Company against the Hatch Storage Battery Company, affirming the decision of the Circuit Court of Judge Colt, wherein the Hatch battery was held to be an infringement of the Brush patent, owned by the Electric Storage Battery Company, and an injunction granted against the further manufacture and sale of the Hatch battery.

The opinion says that the Hatch battery "is clearly an infringement" and "it also seems clear to us that the respondent has taken the complainant's device," the court therefore affirmed the decretal order applied from, with special reference to the first claim of the Brush patent, which is the basic claim.

This is claimed to be the most expansive legal victory yet won by the Electric Storage Battery Company and is said to secure to it a continuation of its monopoly during the life of the patent on batteries composed of "a plate or suitable support primarily coated or combined with a chemically applied oxide of lead or equivalent lead compound."

This litigation has been pending for the past three years and has been most vigorously contested throughout, the Electric Storage Battery Company being represented by patent-counsel John R. Bennett, of New York, and the Hatch Company by Messrs. Causten Brown and Alexander P. Brown, of Boston.

Mr. B. H. Scranton, president of the American Electric Heating Company, of Detroit, spent some days last week in New York.

FIG. 5.—"COLUMBIA" ELECTRIC DELIVERY WAGON.

The Absorption of the Third Avenue Railroad System of New York City by the Metropolitan Street Railway Company.

The purchase of the Third Avenue Railroad system by the Metropolitan Street Railway Company, which was announced on March 19, places the whole of the surface traction equipment of New York city in the hands of a single corporation. Mr. H. H. Vreeland, the president of the Metropolitan system, has been duly elected president of the Third Avenue system and the two will be worked together as a complete whole.

The former system of the Metropolitan Street Railway Company embraced a mileage of somewhat over 230 miles of track. The mileage of the Third Avenue system is about 175 miles, making a total mileage of surface track to be operated by the Metropolitan Company of over 400 miles in the boroughs of Manhattan and the Bronx, in New York city.

In many, if not all, respects this railway system is the most important of its kind in the world. While several other systems exceed it in physical magnitude, that is, in track mileage, it handles probably the densest traffic in the world and certainly carries a larger number of passengers than any other similar aggregation. In addition to this its equipment represents all that is best and most modern in street railway practice. It has a system of open slot conduit electric railways that stand as a model for urban street car lines.

Now that this company has under its control all the street car lines of two boroughs of the city it is certain that wide and sweeping betterments in transit service will be made. The ideal to which Mr. Vreeland desires to attain in transportation is that a man may go from any point of Manhattan Island to any other for a single fare of five cents.

It is expected that large economies will be instituted in the operation of the system and that the proposed new power house for the Third Avenue lines will not be built, as there is sufficient power to be had from the new power house of the Metropolitan Railway system at the foot of Seventy-sixth street, on the East River, in Manhattan, to operate the whole system. No other city has shown so well the convenience of having its street car lines under one management as New York and it is expected that the service which will be given in the future by these lines will be better than any other given elsewhere in the world at the same price.

FIG. 6.—"COLUMBIA" ELECTRIC DELIVERY WAGON.

Woods Electromobiles.

Among the interesting types of electromobiles that have been devised by American makers, none possess more features of originality and show more careful study of the conditions surrounding their use than electric delivery wagons. Fig. 1 illustrates a special type of delivery wagon for a haberdasher, manufactured by the Woods Motor Vehicle Company, of Chicago.

To adapt themselves to the requirements of the various sorts of merchandise which they are engaged in delivering, these wagons are made in a large variety of shapes; they generally express in their external appearance some peculiarity of design that attracts attention and makes them useful at once as vehicles for the transportation of goods and as perambulating advertisements for the concerns to which they belong. In Figs. 2 and 3 are shown delivery wagons for a department store and a piano warehouse. The latter is a particularly interesting vehicle, not only in its departure from the usual type of wagon, but also because it is engaged in transporting exceedingly heavy articles of merchandise. An ordinary upright piano in its box weighs about fifteen hundred pounds. This particular vehicle is in use in Cleveland, Ohio, and is a remarkably handsome example of its class. The other vehicles show so plainly in the illustrations the various purposes for which they are intended that no detailed description of them is necessary here. A general description therefore, will suffice for the whole. The running gear and axles of these wagons are made of solid steel, hand forged. The wheels are throughout fitted with ball bearings and solid rubber tires, while steering is accomplished by means of knuckles on the front axles. These steering knuckles are also fitted with ball bearings and are arranged to turn to an extreme angle of 45 degrees in either direction. This suffices to give the wagons an exceedingly small radius of steering and to make them particularly easy to handle in crowded thoroughfares and blockades. Two motors of similar construction are used on each, geared by a single reduction gearing to the rear wheels. The motor pinions are constructed of rawhide in order to reduce the noise and vibrations of operation to a minimum and the motor bearings are also on the ball principle so that throughout the vehicle there is an entire absence of sliding bearings. The motors are self-contained and enclosed, being therefore both dust and waterproof. Three speeds forward and one in the reverse direction are provided by a controller which commutes the arrangement of batteries and motor, and in the circuit with this is a key which, upon its removal, leaves the vehicle entirely without ability to move itself and renders it to that degree incapable of malicious or mischievous interference. One can leave such a vehicle without attendance in the street without fear that it will be stolen during his absence.

The batteries have been reduced, according to the claim of the makers, to much less than their former weight and size and are stowed away in the least possible compass in the wagon so as to be as little as possible in evidence. All parts of them are interchangeable and the cells which contain them are sealed to avoid the splashing of their contents when the vehicle is operated over rough roads.

The brake is so inter-connected with the motor as to be operated by the controller lever. In this way it is impossible to apply the brake without first shutting off the current, nor can the current be turned on without first releasing the brake. It is claimed by the makers that these vehicles will operate from 50 to 75 miles a day subject to the facilities for charging, the nature of the roads and grades encountered, and other considerations.

FIG. 1.—WOODS SPECIAL ELECTRIC DELIVERY WAGON.

FIG. 2.—WOODS ELECTRIC DELIVERY WAGON.

Fig. 4 exhibits an interesting type of electromobile used by the United States Post Office Department for the collection of mail from street letter-boxes in the city of Chicago. This is only one of the several types of similar vehicles, the points of difference being mainly in the size and capacity of the body, as the vehicle is to be used for heavier or lighter collections. On a practical test of these vehicles in Chicago one was found to be able to cover two collection routes in the same time that was formerly taken by the horse-drawn vehicle in covering one.

In addition to these types the Woods Company also manufactures a number of what may be called pleasure vehicles from broughams and victorias to little runabout buggies adapted for one or two persons. A special type of vehicle is constructed for the use of physicians who have discovered that for emergency calls nothing is more ready or quicker to be put in service than an electromobile. In fact for such service these vehicles are ideal, since the physician may be half way to his patient by the time that a horse-vehicle could be harnessed and ready for his service.

The Helios-Upton Company's Storage Batteries.

The Helios-Upton Company, whose manufacturing plants and offices are located at 222 to 226 Fullerton avenue, Chicago, at Philadelphia, Pa., and at Peabody, Mass., is manufacturing a new line of storage batteries known as the Morrison system. These batteries are adapted for all purposes and a new process of electrochemical formation is used in their manufacture. The maker states that Morrison batteries are characterized by long life, high efficiency and great capacity. They are well adapted for central station, power and isolated plant service, and the Helios-Upton Company makes a specialty of automobile cells. It is stated that these batteries will maintain their voltage at a constant discharge-rate of six amperes per pound of battery, if required, and it is also asserted that the battery may be called upon for, and will deliver, in one hour 80 per cent of its stored energy without suffering any injury. The company issues circulars describing the Morrison batteries and will be glad to correspond with manufacturers of automobiles in regard to making storage batteries to their specifications.

Mr. Charles J. Glidden, president of the Erie Telephone system, has been visiting New Orleans and it is thought that his presence in that city has some significance in telephone affairs in the state of Louisiana and vicinity. Mr. Glidden and his party, which included Hon. Charles E. Adams, of Lowell, Mass., the president of the Massachusetts Board of Trade, are on their way to inspect the property of the Southwestern Telephone and Telegraph Company in Texas and Arkansas.

Wall Street and the Electrical Stock Market.

The official announcement on Tuesday morning of this week that the Metropolitan Street Railway Company had acquired the Third Avenue Railroad Company startled the stock market which passed at once into a state of greater animation than has been witnessed for many months. The common opinion was that the Third Avenue and Metropolitan deal was the main cause of the radical change in speculative conditions. The purchases of Third Avenue stock by the Metropolitan road were concealed with a skill almost unparalleled in the history of Wall street, and the stock rose from 45 to 112. Some excitement was caused on Friday afternoon by a rumor that the Metropolitan Street Railway Company was about to ask the Stock Exchange to list $25,000,000 additional stock. The report was promptly denied and the rumor was regarded as a Wall street trick. The market closed the week by resuming its upward course with the trading marked by animation.

FIG. 3—WOODS ELECTRIC PIANO WAGON.

FIG. 4—WOODS ELECTRIC MAIL COLLECTION WAGON.

On the New York Stock Exchange, General Electric closed the week at 130 bid and 131 asked, a gain of 4 points for the week. Metropolitan Street Railway, of New York, closed at 162 bid and 162¼ asked, a gain of 1¼ points for the week. Third Avenue Railroad, of New York, closed at 102½ bid and 103½ asked, a gain of 35 points for the week. Brooklyn Rapid Transit closed at 67¾ bid and 67⅞ asked, a gain of ⅞ point for the week. Manhattan Railway, of New York, closed at 94½ bid and 95⅛ asked, a gain of 1⅞ points for the week. There was a rumor during the week that capitalists interested in the Metropolitan Street Railway, of New York, had acquired a large block of Manhattan Railway stock.

On the Boston exchange, American Bell Telephone closed at 314 bid and 315 asked, a loss of 1 point in the bid price for the week. Erie Telephone closed at 104 bid and 105 asked, a gain of 1 point for the week.

On the Philadelphia exchange, Union Traction closed at 38 bid and 38⅛ asked, a gain of 1⅛ points for the week. Electric Company of America closed at 12¾ bid and 13 asked, a gain of 1½ points for the week.

On the curb, or outside market, in New York, Electric Vehicle closed at 38 bid and 40 asked, a gain of 8 points for the week. Electric Boat closed at 23 bid and 24 asked, a gain of 6 points for the week.

Wall street, March 24.

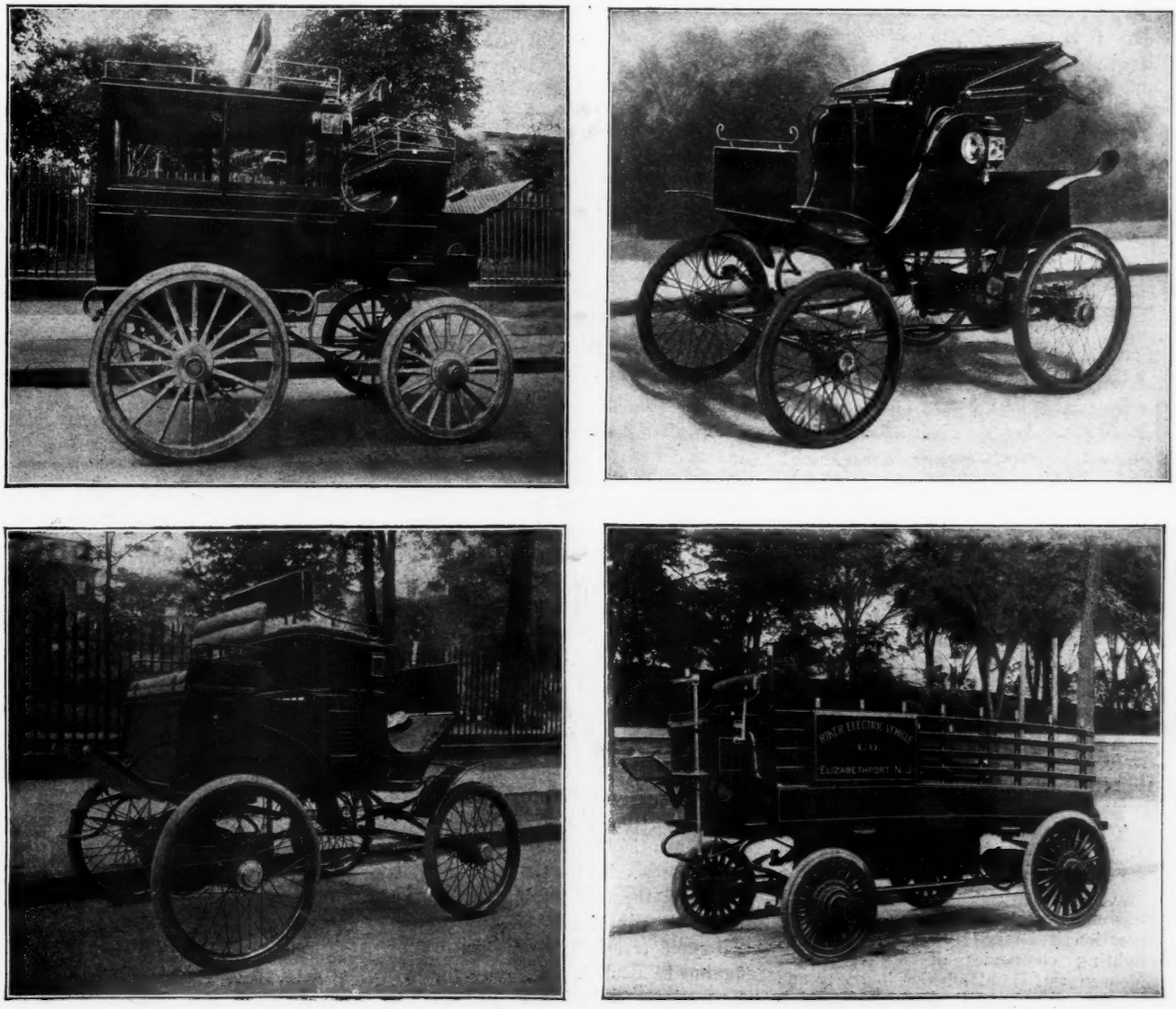
Riker Electromobiles.

The special feature of the Riker electromobile vehicles which are manufactured by the Riker Electric Vehicle Company, of Elizabethport, N. J., is the running gear. This consists of a light steel tubular frame, without trusses or rockers, and so constructed that it is flexible to the irregularities of the road, but maintains rigidly the alignment of the wheels and their distance apart. On all the vehicles built by this company, with the exception of the small runabout, wooden spoke wheels, having solid rubber tires, are used. The runabout, being a very light vehicle, is fitted with wheels of the bicycle type having tangential wire spokes, wooden rims and pneumatic tires. This variety of tire is also used on some of the other vehicles. All the wheels are provided with roller bearings and all the vehicles have electric lights, electric alarm gongs and, when so desired, electric foot warmers.

The batteries are installed in four cases, each containing eleven cells. Control is effected by the usual grouping and interconnection of the various elements of the battery, the controller being placed under the seat of the vehicle and operated by a single upright lever convenient to the left hand of the operator. In its vertical position the current is cut off, while movement of the handle forward sends the vehicle forward, and movement backward sends it backward. There are three speeds forward and two backward. An ingenious arrangement insures against danger of reversing the vehicle while it is moving forward through a too sudden movement of the handle backward, consisting of a button in the end of the controller handle which must be pressed by the thumb of the operator before the lever can be thrown into the reverse position.

The motors used on these vehicles are of a multipolar iron-clad type, impervious to dust and water, and operated at a pressure of 80 volts. According to the speed and weight of the vehicle to which they are attached, these motors range from three-quarters of a kilowatt to five kilowatts in capacity.

The pivoting of the front wheels for steering is accomplished by a hub pivot of the internal type, so that the axial line of the pivot coincides with the point of tread of the wheel, thus preventing any jarring due to uneven ground from being transmitted through the steering wheel to the operator's hand. The brake is operated by a foot lever and consists of a steel band acting on the gear. Other vehicles are fitted with additional emergency brakes operating by hand and act-



FIGS. 1-4.—RIKER ELECTROMOBILES—THEATRE BUS, PHAETON, DOS-A-DOS AND TRUCK.

ing on the rear tires. Each of these vehicles is fitted with a charging plug and socket so constructed that the battery may be recharged without removing it from the vehicles when this is desirable.

Both single and double motor equipments are used in the many styles of vehicles illustrated herewith. In the case of the single motor equipment the compensating gear, instead of being in the middle of the shaft, necessitating that the driving axle be cut in two and thus weakened, it is placed in one of the hubs so that a strong continuous axle may be used. The illustrations shown here represent a few of the types of electromobile vehicles constructed by this company, and include a theatre bus, a dos-a-dos, a truck and a phaeton.

ELECTRIC LIGHTING

The Imperial Light, Heat and Power Company, of St. Louis, Mo., has increased its capital from $200,000 to $1,510,000.

It is reported on good authority that the two electric light companies of Atlantic City, N. J., the Lighting Company of North America and the Atlantic City Gas and Water Company, are to be combined.

Governor Roosevelt has signed the bill of Assemblyman West legalizing the erecting and maintenance of the dam of the Hudson River Power Transmission Company across the Hudson River near Mechanicville, N. Y.

The Consolidated Electric Light and Power Company, of Birmingham, Ala., is now constructing a duplicate of its large plant to furnish electricity for lighting and power purposes not only to Birmingham, but all the suburbs of Birmingham.

The property of the Merchantville, N. J., Light, Heat and Power Company and the Merchantville Gas Company has been purchased by the Camden & Burlington Gas and Electric Company. This corporation is already in possession of the lighting companies of Mount Holly, Moorestown, Haddonfield, Gloucester and Woodbury. F. A. Downs, of Merchantville, who was president and controlled most of the local companies, has been retained as director. A large addition will be built to the local electric plant, and it is said the country for several miles around will be furnished light and power from here.

Plans for the Susquehanna Electric Power Company have been developed so far as to make it probable that electric power generated from the falls of the Susquehanna River may in a short time be brought to Baltimore for lighting and manufacturing purposes. This power, it is said, will be delivered to consumers on terms similar in many respects to those on which consumers in Buffalo and other neighboring cities are supplied with electricity generated at the great plant at Niagara Falls. The Susquehanna Company has been at work on its project for about five years. About 80,000 horsepower is available.

ELECTRIC RAILWAYS

It is reported that a new third-rail road, backed by a capital of $2,000,000, is to be built from Hudson to Albany, N. Y. C. W. Blakeslee & Sons, of New Haven, it is said, have been awarded a contract for the construction.

A Boston syndicate has purchased stock control of the Worcester, Mass., & Suburban Street Railway Company at from $100 to $115 per share. The Worcester & Suburban owns 30 miles of road. Its capital stock is $550,000 and it has a bonded indebtedness of $200,000 and a floating debt of $200,000.

Property owners along the line of the proposed electric road from Oxford to Clifford, Mich., and beyond are greatly interested. The line will touch at Thomas, Metamora, Hunters Creek, Lapeer, Five Lakes and North Branch. It is to be known as the Oxford, Lapeer & North Branch Railway. Simons & Curry, of Detroit, are pushing the scheme and they have interested influential men in the different towns in their project. Each of the above towns will subscribe liberally. A Lapeer gentleman starts the ball rolling with a cash bonus of $1,000.

Senor Villalon, secretary of public works, of Havana, Cuba, says the opening of the electric railroad, on March 9, though the line is only a few miles in extent, was the beginning of a great commercial prosperity for Cuba. The return trip, over the road, including stops, he says, took only 11 minutes, which means that rapid transit will within a reasonable time be assured. Several branches of the road are to be built. The company building the road, though an American corporation, is largely controlled by Canadian capital. The line will extend beyond the immediate suburbs as soon as a more liberal interpretation shall have been placed upon the Foraker resolution, and will touch Bay Cojimar and Santa Maria del Rosario. General Manager Goudio thinks that the success attained by the electric road will mean a considerable increase in American capital in the Island, the capital at present invested being chiefly English and German.

TELEPHONE AND TELEGRAPH

The Bell Telephone Company has decided to build a line from Cortland to Burghill, Kinsman, Bristolville and West Farmington, Ohio, at a cost of $40,000.

The Pacific Coast Telephone System made a net gain of 2,321 subscribers in February; total number connected March 1 was 69,014, of which 17,941 are in San Francisco.

It is reported that the Telephone, Telegraph and Cable Company of America is desirous of securing all the franchises of the telephone companies in Philadelphia with the exception of the Bell, in order to get a new franchise for itself.

The directors of the Wisconsin Telephone Company have declared dividend No. 71, one and three-quarters per cent, payable April 9, 1900, to stock of record, March 31. The stock books will be closed from March 31 to April 9, 1900.

The directors of the Michigan Telephone Company have declared dividend No. 63, one and one-quarter per cent, payable April 9, 1900, to stock of record, March 31. The stock books will be closed from March 31 to April 9, 1900.

The directors of the Erie Telegraph and Telephone Company have declared dividend No. 66, one and one-quarter per cent, payable April 9, 1900, to stock of record of March 31. The stock books will be closed from March 31 to April 9, 1900.

A Pittsburgh despatch says that the Telephone, Telegraph and Cable Company of America has purchased for $220,000 cash the Union Telephone and Telegraph Company, which comprises all the independent telephone lines in northwestern Pennsylvania.

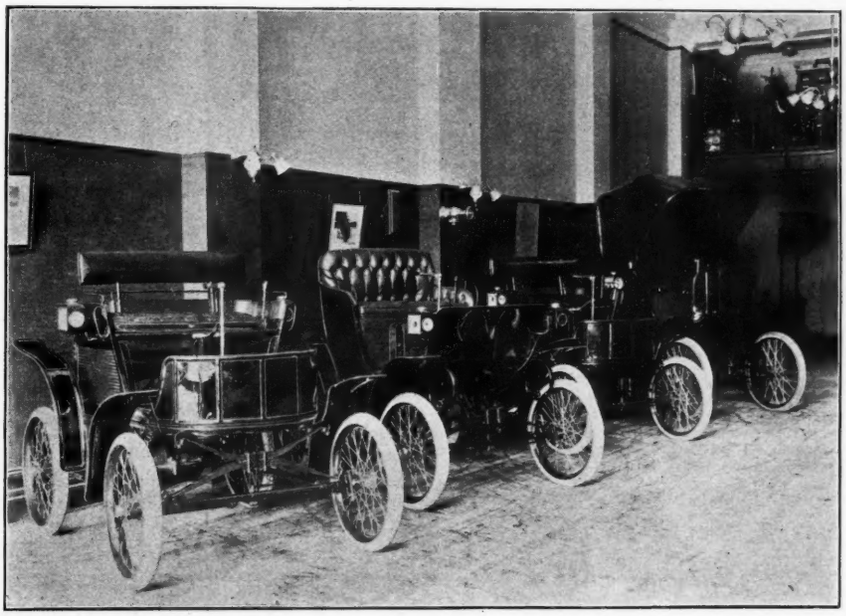
At the annual meeting of the stockholders of the New York & New Jersey Telephone Company, of Brooklyn, N. Y., the following were reelected directors: Charles F. Cutler, Alexander Cameron, Joseph T. Davis, Charles A. Nichols, Hugh Kinnard, W. D. Sargent, David Powell, George H. Prentiss, Felix Campbell, Edward J. Hall, Henry Sanger Snow and Zenas Crane.

The Chicago Telephone Company has declared a cash dividend of three per cent for the first quarter of this year and a stock dividend of $1,000,000. Stockholders will be privileged to subscribe for $500,000 additional stock at par. Next October there will be a second issue of $500,000 of new stock at par. The outstanding capital is $5,000,000 and the distribution of the stock dividend will be in the ratio of one share of new stock for each five shares of old.

The New Repair Department and Charging Station of the New York Electric Vehicle Transportation Company.

In the large brick building formerly occupied as a car barn by the Eighth avenue surface railroad in the days of horse traction, and situated at the corner of Fiftieth street and Eighth avenue, in New York city, the New York Electric Vehicle Transportation Company has installed a highly modern station for the charging and repairing of electromobiles.

This company now has in operation upon the streets of New York city more than two hundred public electromobile cabs. Of these vehicles there are no less than 12 styles—three varieties of broughams, two kinds of hansoms, two different types of victorias, etc. The new station was designed to supplement the present charging station which fronts on Seventh avenue and Broadway between Fifty-second and Fifty-third streets.



VIEW IN THE SALESROOM OF THE NEW YORK ELECTRIC VEHICLE TRANSPORTATION COMPANY.

Most of the ground floor of the new establishment is devoted to the charging of electromobile cabs and other vehicles, it being the intention of the company to furnish current for recharging batteries of electric vehicles belonging to private owners. For this purpose the walls are equipped with simple rheostat and magnetic limit-switch devices adapted for the accommodation of about one hundred vehicles while charging with their batteries in place. For the recharging of the public cabs, in which the battery sets and boxes are of standard size, weight and capacity, a system of great simplicity and ingenuity has been devised and is now in progress of establishment.

The incoming cab runs through guides to its charging station with its battery receiving end facing and perpendicular to a small track. Upon this track runs a four-wheel hand-car, carrying two tracks upon its platform surface perpendicular to the main track below, thus forming a species of transfer table. On either side of the middle position of this platform truck are elevated tracks, before any of which it can be stopped. A number of low four-wheel battery trucks, each capable of holding one box of accumulators such as is put aboard of an electromobile cab, are provided and normally rest upon these transverse elevated tracks. Upon them are batteries in process of charge. Their sides are so arranged that when the battery is set upon them a single movement of the hand throws up the contacts and sets the battery charging. A similar simple motion releases the contacts and leaves the battery in place on its small truck fully charged.

Opposite the position of the incoming cab with its discharged batteries is a device consisting of a steel plunger, provided at its end with fingers and operated by a screw and hand-wheel gearing. On either side of this are levers, and, when the cab has backed into position, by throwing one of these over, a strong jack is brought up under the axles of the cab, holding it securely in position and preventing any movement of the vehicle while the battery box is being removed. The plunger is then forced forward until its fingers engage in appropriate openings in the battery box, and the transfer truck, having upon one of its tracks one of the small trucks, is rolled into position to receive the battery as it is withdrawn by a backward movement of the plunger. As soon as this is accomplished the fingers are released, the transfer truck is moved along bringing a new set of batteries into place and these are forced forward into the cab by another movement of the same plunger. In less than two minutes after the cab with discharged batteries comes into the building it can be sent out again on the street with a fresh supply of accumulators and its exhausted battery on the charging table receiving another charge.

The new types of cabs now being placed in service by this company differ only in slight degree from those that are familiar objects on New York streets. The wire wheel and the sheet metal wheel have been discarded in favor of a wooden-spoke built-up wheel of solid construction, carrying a pneumatic tire. Hereafter all new vehicles will contain steering arrangements operating on their forward wheels while power is applied to their rear wheels. The steering handle also will be made to swing through a horizontal plane and not fore and aft in a vertical plane as at present. The complete cab weighs about 4,000 pounds and of this weight its battery outfit comprises about 1,600 pounds.

Upstairs in the new station is devoted entirely to repair and reconstruction of vehicles. Considerably the largest portion of the repair work is entailed by the carelessness of drivers of horse vehicles and cable cars who seem to have little compunction in "ramming" an electric cab whenever the opportunity presents itself. On this floor of the building are forge shops, machine shops, painting shops and departments for the overhauling and renovation of upholstering and other carriage fittings. It is expected that a considerable number of privately owned electric vehicles will also be brought to this establishment for repairs as well as for charging. A powerful elevator connects the upper and lower floors and is able to handle a loaded cab with ease.

An interior view of this company's salesroom and repository is shown herewith. The salesroom is a handsome store at 541 Fifth avenue, New York city, at the corner of Forty-fifth street. It has been beautifully fitted up and is in charge of Mr. James Joyce, Jr., assistant to the president of the company. There are no charging facilities at this repository. It has been designed to be the general headquarters of the company as well as a salesroom.

AUTOMOBILISM IN EUROPE.

THE PRINCIPAL AUTOMOBILE EVENTS IN EUROPE DURING THE EXPOSITION—RACES AND CONTESTS—NOTES BY OUR FRENCH CORRESPONDENT.

BY C. L. DURAND.

This year promises to be an interesting one from an automobile point of view. The Paris Exposition will be the center of a number of events, such as contests, races and expositions, and for these the committee in charge is making active preparations, aided by the Automobile Club of France, under whose auspices these different events will be held. An annex to the main exposition has been laid out at Vincennes Park, just outside the city limits, in which will be included the section of locomotion, including electric traction and automobiles. To provide for the latter a race track is now being constructed around the Lake Daumesnil; for the section of automobiles, the sum of $20,000 has been set apart to cover the expenses of constructing the track, the stands, sheds for vehicles, charging station, etc. This sum includes also the prizes which will be awarded by the committee to the winners in the different contests. The Automobile Club of France has lately published the programme of the principal events to be held in the Summer and Fall; of these there is to be one every month, of five days' duration. They will take place in the following order: May 14, international competition of road vehicles; June 18, cabs, electric and other types; July 23, automobile races, in which will be entered a number of newly designed types, especially constructed for high speed; August 13, class of small vehicles for two persons, phaetons, etc.; September 17, delivery wagons, for light merchandise; October 8, class known as "heavy weight," large delivery wagons, omnibuses, etc.

Among the interesting events of the season will be the international contest for the cup which has been presented to the Automobile Club of France by Mr. James Gordon Bennett. This cup is to be the object of a series of contests to be held every year; it will remain in the hands of the Paris club until defeated by one of its rivals. The race will begin on June 14, over a route which has been recently decided upon, beginning at Paris, and passing through a number of towns to Lyons, a total of 330 miles. According to the rules laid down for this event, the cup is to be competed for by one of the officially recognized clubs of the different nations, each of which is to send from one to three equipments. The vehicles are to weigh at least 900 pounds and carry two or more persons; 155 pounds is allowed per person, or the deficiency to be made up by weight. Each club is to certify that its vehicles are entirely of home manufacture; they are to be conducted by members of the clubs. Unlike the former series of tests organized by the Automobile Club, the present event is to be one of speed alone, and accordingly the vehicle arriving first will carry off the cup for his club, which is to hold it until the next year's race decides the owner. The entries closed on the 31st of December, last; the clubs which have announced their intention of entering the contest are those of the United States, Germany, Belgium and Italy. The automobile clubs of Austria and Switzerland have announced that they will not take part until next year, as the state of the industry in those countries has not yet sufficiently developed for them to be able to furnish vehicles of home make and to comply with all the rules laid down. It is to be regretted that England will not be represented this year, but with the five countries, including France, which will compete for the cup, an event of great interest is assured.

England, however, is to have a great contest in the shape of a 1,000 miles' tour for automobiles over a route laid out from London to Edinburgh and back. It will take place from April 23 to May 11, inclusive. Besides the proposed tour, a series of expositions will be held in each of the seven principal cities passd through on the route. The tour will be preceded by an automobile exposition to be held in London, at Agricultural Hall, under the patronage of the Automobile Club of Great Britain and Ireland. This will last from April 14 to 21 and will probably be followed by another exposition, reserved for the vehicles which have made the tour. This latter will no doubt be held in Prince's Skating Club, in London, May 12 to 19. The route to be covered is as follows, an exposition being held in each of the cities named on the day following the arrival of the automobiles: April 23, London to Bristol, 120 miles; April 24, exposition at Bristol; April 25, Bristol to Birmingham, in three stages, a total of 86 miles; April 27, Birmingham to Manchester, in three stages, 80 miles; April 30, Manchester to Carlisle, in seven stages, 138 miles; May 1, Carlisle to Edinburgh, in five stages, 100 miles. At the latter city a large exposition will be held on May 2, after which the return trip will follow a route passing through Newcastle-on-Tyne, Leeds, Sheffield, Northampton, to London. A long series of rules has been drawn up, in which it will be noted that the contest is open to home and foreign competitors. The vehicles are divided into three classes; automobiles entered by manufacturers, those owned by private persons, and a third class for detached pieces and accessories. The first two classes are subdivided into five sections each, according to the value of the vehicle, this ranging from $1,000 to $2,000 or more; the last section includes motorcycles, etc. The limit of entry has been fixed for April 14, the fee to be $200. At each of the principal points of the tour a committee of experts will examine the vehicles and report upon their performance. The contest is designed, not as a trial of speed, but rather as one of endurance and general performance of the vehicle, and accordingly the committee will lay special stress upon these points in awarding the certificate and prizes; the latter amount to $125,000 in all. Besides, the *Daily Mail* will give a special prize of $50 to each vehicle, belonging to private owners, which makes the tour successfully.

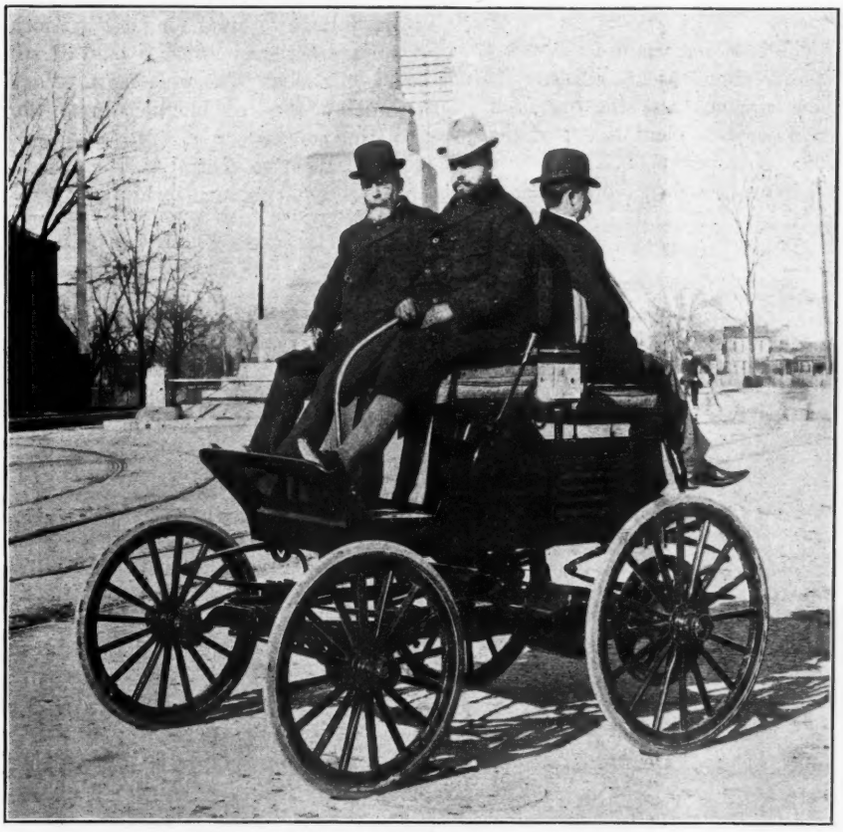
The following is a list of the principal automobile events for the year 1900 which have been decided upon up to the present time: March 11, Paris-Rouen-Paris; March 26 and 27, Nice-Marseilles-Nice, races; March 26 and 27, Nice-Draguignan-Nice, road vehicles; March 29, Nice, races reserved for vehicles which have made the Nice-Marseilles tour; March 30, Nice-La Turbie, reserved for vehicles making the tours Nice-Draguigan and Nice-Marseilles; April 15, Paris-Roubaix; April 26, electromobiles, Paris-Dijon; May 23, Paris-Bordeaux races, single stage of 310 miles; June 10, Paris-Reims; June 14, Gordon Bennett Cup, Paris-Lyon; June 24, Baden, races over the route Helmenthal-Siengenfeld; June 24, Brest-Rennes and return, 180 miles; July 1, Salon-Arles and return; July 9, International Congress of Automobiles, Paris; July 29, Automobile reunion at Baden, lasting until August 5; September 1 and 2, Paris-Ostende, 200 miles; September 9, Baden, races of 36 miles.

Among the new types of French electromobiles which have lately appeared may be mentioned the new phaeton constructed by the Creanché Company; this is arranged for two places, and has a total length of about six feet. Its motor will give four horse-power, and drives the rear

wheels by differential and chain gearing. The wheel of the controller is inclined toward the conductor; this controller makes all the combinations for front and rear motion, electric brake, etc., with the use of a single wheel. Two batteries of accumulators are used, of 44 elements in all; they are contained in seven boxes, three in front of the conductor and four in the rear of the vehicle, and are arranged so as to be easy of access. They will give 15 amperes for five hours discharge. En route, 10 amperes are taken normally, at 90 volts, making 900 watts; the accumulators are disposed so that they can be charged without taking them out of the vehicle.

M. Krieger, whose electromobiles have been among the most successful in the annual contests held in Paris, has lately constructed a new racing vehicle with which he hopes to break the record in the races of this year at Vincennes Park. He adheres to the same general system in use in the larger vehicles, that is to say, the front wheels are driven independently, each by a separate motor, whose pinion gears with a large wheel on the inner side of the driving wheel of the vehicle; the motor and wheel constitute a system which turns about a pivot, the central part of the axle remaining fixed. The motor is, however, placed horizontally, the outer end resting upon a curved spring. The accumulators are placed in front of the conductor, and the box has a forward slope in order to diminish the air resistance.

PARIS, March 16, 1900.



THE THRESHER ELECTROMOBILE BREAK.

Thresher Electromobiles.

Realizing the increasing demand for an electric vehicle that would in efficiency, durability and ease of manipulation meet the severe requirements demanded of the automobile, the Thresher Electric Company, of Dayton, Ohio, has given its attention to the designing of such a vehicle. The result of its tests and experiments has been the production of the wagon shown in the illustration. It has been put through the most severe tests, under the most trying circumstances to be met with in actual service, and the results have far surpassed the most sanguine expectations of its inventor.

The illustration represents a four-passenger break, which was loaded for its first run with no less than 1,500 pounds of passenger weight. This abnormal load was handled with the greatest ease, there being no perceptible additional effort.

The vehicle complete, without passengers, weighs 2,200 pounds.

The body was manufactured by Morris Woodhull, of Dayton, Ohio. It is strongly built and has the advantage over many vehicles of appearing to be constructed especially as an automobile. The wheels are ball-bearing, the tires being two-inch solid rubber. The steering is done by the front wheels which are pivoted on the axle.

The frame is of a new type, the weight being supported at three points. The front axle is pivoted, giving great flexibility to the frame and adjusting itself to the inequalities of the road, so that it is possible to make sharp turns at full speed without tendency to tilt. The springs being mounted upon this rigid frame keep the body of the wagon in its normal position.

The electrical equipment consists of two 1½-horse-power motors, geared independently to each one of the rear wheels. These motors, though of special design for this particular class of work, are upon the lines of the enclosed motor which has been manufactured by the Thresher Electric Company for years and are covered by very broad patents. The motor case, while entirely protecting the working parts, is so designed as to afford ease of access for inspection and renewal of brushes. They are pivoted upon the rear axle and flexibly supported upon the frame so as to relieve the jar.

By means of a carefully adjusted system of control, four speeds are attained either backward or forward, three, seven, 10 and 15 miles per hour. This variation in speed is attained by a special method of control, without introducing external resistance, nor too great manipulation of the batteries, making an extremely efficient and simple method of control.

The battery is a novel feature of the vehicle, consisting of 40 cells of the Faure type, arranged in four banks. This battery has a capacity of 120 ampere-hours, each cell weighing, complete, but 20 pounds.

With this extremely light equipment the vehicle has been driven over 50 miles, over hilly country roads, on one charge, though in its construction no attempt has been made to produce a racing vehicle. Considering the very light equipment, this mileage is certainly a remarkable performance. All classes of roads have been gone over with the greatest ease, and the ease with which the vehicle surmounts the steepest hills has proved its adaptability for this class of work.

In addition to the type of vehicle shown, the Thresher Electric Company is manufacturing a complete line of vehicles, including runabouts, stanhopes, broughams and all classes of light and heavy delivery wagons, to meet the demand of all users. The extreme lightness and efficiency of the electrical equipment makes it possible to produce a vehicle that will give the maximum radius of operation with the minimum amount of dead weight to be carried. The fact that the complete equipment is produced in the shops of this one company gives it the advantage of having each part especially adapted to the requirements of the other.

While in Dayton, recently, a representative of the ELECTRICAL REVIEW had an opportunity to ride in the break illustrated, and was greatly impressed by the speed and ease of control shown by the vehicle. Its motion is extremely easy, and its radius of operation on a single charge very large.

VIEWS, NEWS AND INTERVIEWS

In the United States Court, at New Haven, Ct., lately, Judge Townsend decided for the plaintiff in the case of the Commercial Cable Company, of New York, against the schooner William H. Bailey, and awarded the plaintiff $5,000 damages. The schooner on December 27, 1898, anchored during a gale in New York harbor. After the storm had subsided the crew attempted to pull up the anchor and found it caught in the cable. The crew thereupon cut the cable with a meat saw.

The brig John D. Spreckels has sailed from San Francisco for Guam, carrying mails and freight. This is the first vessel which has ever left San Francisco for the Ladrones with a cargo of merchandise. The bulk of the cargo is for the stocking of a store, to be owned and operated by a company at Guam. There is also a telephone plant on board, which will be put up and operated by the company.

An interesting letter from a gentleman in Newburyport, Mass., describes some of the early days of the automobile. It appears that one Nat Austin, of Lowell, Mass., who was an old-time circus clown, made a steam automobile about 1853 and used to run it along with the parade of the show to which he belonged. He had a great habit of going, on Sunday, between Lowell and Boston, in this machine, and when prosecuted for scaring horses, as he frequently was, took refuge in the protection of an old statute which claimed that a man riding horseback on Sunday without the excuse of necessity or mercy took his own risks. He was never unsuccessful with this defense.

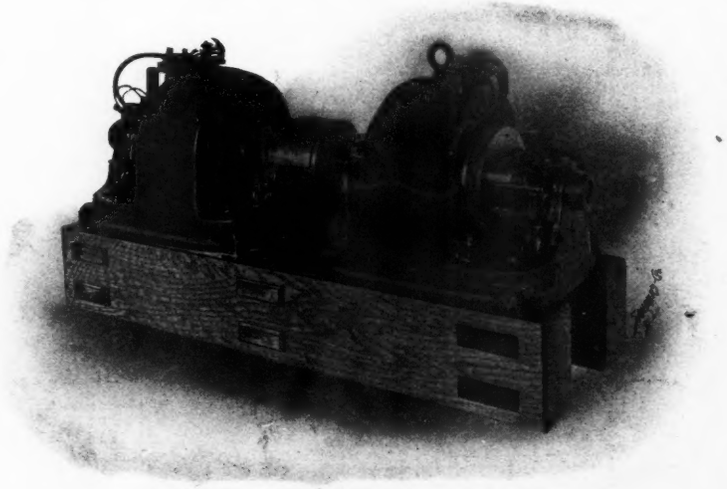
The Buffalo, N. Y., *Express* carries this interesting sub-head under its title: "Printed by electric power from Niagara Falls."

Officers of the Cuban Submarine Cable Company have called upon the acting-Secretary of War and presented to him claims for damages for the action of the American naval authorities in Cuban waters during the war with Spain in cutting the cables of the company. Two claims were filed, one of $40,000 for the actual cutting of the cable, and the other for an annual subsidy of 10,000 Spanish pesos, gold, to be paid until 1910. As the payment of subsidies rests with Congress alone, the second claim was transmitted to that body. The other claim will be decided by the War Department.

Electromobile Charging Outfits.

In the application of electricity as the motive power for automobiles a demand has arisen for reliable apparatus for the charging of storage batteries. Direct-currents can generally be obtained only in limited areas of large cities, as most central stations supply alternating-currents only. This necessitates for the charging of storage batteries either a separate plant for the production of direct-currents, or a piece of apparatus for the transformation of alternating into direct-currents.

The most important conditions are reliability, simplicity and efficiency. Under these circumstances the operation of a small separate plant is out of the question. An open field is left to reliable apparatus, simple in operation, for the transformation of alternating into direct-currents.



A WAGNER ELECTROMOBILE CHARGING OUTFIT.

These conditions have been admirably met by the Wagner Electric Manufacturing Company, of St. Louis, Mo., by the production of an outfit consisting of a single-phase alternating-current motor, joined by an insulating flexible connection to a direct-current generator. Both are mounted on a single wooden base, as shown in the illustration, and are thus completely insulated from each other and from their foundation, as required by the National Board of Fire Underwriters. To start the apparatus all that is required is the closing of a single switch, which starts the motor and generator. The closing of a second switch sends the direct-current into the storage battery circuit.

The standard single-phase motors are built to operate on 104-volt and 208-volt single-phase circuits, with frequencies of either 60 or 133 cycles, but can be operated on any phase of a two-phase or three-phase circuit. These are not synchronous motors; they are induction motors of the most advanced type, and do not produce any appreciable variation or fluctuation in the voltage of the circuit on which they are operated. They can be connected to the same mains as arc or incandescent lamps without affecting the lamps in the slightest degree.

The generator furnished with the outfit is of the shunt type, wound to deliver a voltage which may be varied by a field rheostat from 70 to 120 volts. This is the voltage required for most automobile storage batteries which consist of about 40 cells each. The wide range of application of these combinations to any alternating-current circuit will readily recommend them to central station men and others requiring such apparatus. A number of outfits have been installed in the larger cities of this country and abroad.

The Rumford Medal Awarded to Mr. Charles F. Brush.

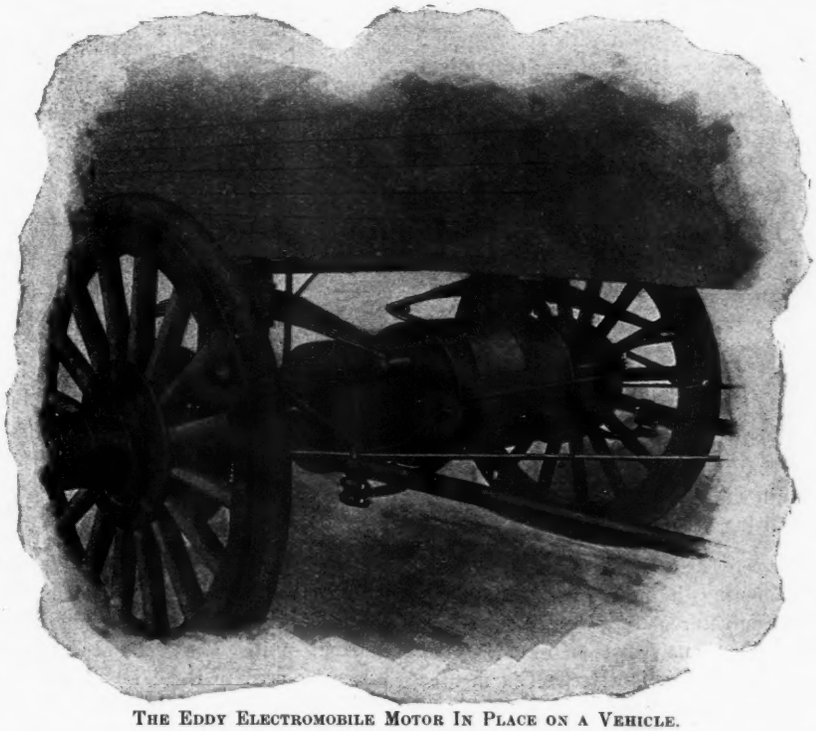
The Rumford Medal of the American Academy of Arts and Sciences has been awarded to Charles F. Brush, of Cleveland, Ohio. This medal is given for exceptionally valuable researches and developments along the lines of heat and light. Mr. Brush won it by the development of the arc lamp, dynamo and lighting system.

The work of surveying the trolley line from Dubois to Oil City and Franklin, Pa., began recently, and the route will take in the following towns and villages in Jefferson, Clarion and Venango Counties: Dubois, Reynoldsville, Brookville, Corsica, Strattonville, Clarion, Shippenville, East Sandy, Oil City and Franklin. The route follows the main line of the old Philadelphia and Erie turnpike.

Electric Motors for Automobiles.

Just as the electric railway required the design and gave the field for the evolution of a new type of electric motor, so the electromobile, with its requirements differing from those of other applications of electric power has necessitated the design of a motor of a type peculiar to itself.

The type of motor herewith illustrated has been produced by the Eddy Electric Manufacturing Company, of Windsor, Ct., for electromobile use and combines those requirements of design necessary to fit it for the peculiarly arduous service required under such conditions. The motors are built for a variety of voltages, the standard rating being 75 volts. This is intended to be used with those vehicles in which 40 or 44 cells of battery are installed, as when full current is drawn from such a combination the voltage at the motor terminals drops practically to 75 volts. Since such a combination of cells can be charged from the usual commercial 110-volt circuit without interposition of much resistance it is thought that it will come to be a standard and for this reason the company has adopted the voltage described.



THE EDDY ELECTROMOBILE MOTOR IN PLACE ON A VEHICLE.

The design of the motor is well shown by the accompanying illustration. It is an enclosed, dust and waterproof type, having a four-pole field with internal poles and an appropriate lid for easy access to the commutator and brush holders. The brush holders are of simple yet strong design, feeding the brushes radially, and are held in position by solid blocks of insulating material designed to stand the constant vibration to which they are subjected without injury. The armature is of the deeply slotted type and wound with formed coils in an interlocking winding. It is also thoroughly banded and is designed particularly to resist centrifugal strains without deterioration. The commutator is large and is built according to modern specifications controlling the construction of such accessory parts. The field coils are made to fit tight on the poles so that they will not work and ride on them while the motor is running and thus become abraded. The terminals of the field and armature circuits are brought out to terminal studs projecting through bushings and provided on their outer end with nuts and washers for binding the ends of the cables from the controller. Either ball or sleeve bearings are furnished with the motors.

It is not believed by the makers that where the battery weight is so great in proportion to that of the motor as it is in most designs, anything is gained by saving a few pounds in weight at the expense of strength and power in the driving machinery. The motors, are, therefore, rated at from 1.6 to 2.4 horse-power, their weights running from 150 to 215 pounds.

Where single motor outfits are to be used the same company also supplies differential gearing so that the two wheels to which the motor is connected may be run at different speeds.

An Electromobile Railway Cab Service.

The first electromobile cab service to be operated in connection with a railway terminal in this country has been inaugurated in Washington, D. C., by the Baltimore & Ohio Railroad. The cabs are furnished by the Washington Electric Vehicle Transportation Company and the service is performed by that concern. The drivers and vehicles are in the exclusive service of the railroad, which has built an electromobile addition to its terminal station, on Capitol Hill, in Washington, putting in asphalt drives on its own property to accommodate the cabs. On incoming trains a folder is distributed by the railway company and orders are taken for carriages by the conductors of the trains, these being telegraphed ahead from Baltimore or Washington Junction. A regular schedule of rates has been made by the railroad company and approved by the Board of District Commissioners. The cabs, of which the accompanying picture gives an excellent idea, are elaborately upholstered in goatskin and finished on the exterior in black and green. A rack is provided on the rear of each for ordinary trunks and the top is arranged with a railing so that hand baggage can be placed upon it. The drivers are uniformed in gray, with tan leather caps and silver buttons and lettering. Service is maintained at all hours of the day and night. Arrangements have also been made by the Baltimore & Ohio Railroad with the various subsidiary companies of the Electric Vehicle Company for service of a similar character in New York, Philadelphia, Baltimore and Chicago.

ONE OF THE B. & O. RAILROAD'S ELECTROMOBILES IN WASHINGTON.

AUTOMOBILES

An automobile club has been organized in Baltimore, Md.

An automobile race will take place in France during the last week in July.

There are five automobile clubs in Belgium, with a combined membership of 740.

A motor omnibus company has been in successful operation in Swansea, Wales, for about nine months, during which period it has carried 120,000 passengers.

The French War Department is now carrying out a series of trials with motor carriages for field guns, and General de Galliffet has stated in the Chamber that there is every prospect of a satisfactory result.

A suburban member of the Automobile Club of America has offered to educate his neighbors' horses so that they will not be afraid of an automobile. On request, he drives his automobile to a man's barn and manipulates the machine before the horse.

The stockholders of the New England Electric Vehicle Transportation Company, which operates the public cab service in Boston, will hold a meeting in Jersey City, N. J., on April 3, to authorize a decrease in the capital stock of the company from $25,000,000 to $5,000,000.

A Hungarian immigrant arrived in New York city the other day, and his sole capital consisted of a twenty-dollar Confederate bill, in consequence of which he was returned to the Barge Office for deportation. And so it comes about that another automobile company will not be incorporated.

The Buffalo Electric Vehicle Company, of Buffalo, N. Y., has elected the following officers: F. A. Babcock, president and general manager; Isidore Michael, treasurer; E. C. Randall, attorney. These gentlemen and Theodore S. Fassett, Leonard B. Crocker, Henry C. Diehl, of Buffalo; and the Hon. Jacob Amos, of Syracuse form the board of directors. This company was recently incorporated and it is stated that work on its manufacturing plant will commence at once.

Manufacturers of automobiles are interested in a recent decision by the Supreme Court of the United States to the effect that the patent on pneumatic rubber tires for road vehicles, which was granted in March, 1893, by the Commissioner of Patents, is invalid, and any one may use such tires without fear of being required to pay royalties. In rendering its decision, the Court called attention to the fact that the advantage of pneumatic tires had been pointed out by Thompson, an English inventor, as long ago as 1845.

"I took Ethel riding in an automobile yesterday," he said.

"Have an enjoyable ride?"

He shook his head.

"The horseless carriage," he said, "is not a success."

"Not a success?"

"No, sir, it is not. Between the motor lever and the brake it gives a fellow more occupation for his hands and arms than even a spirited horse. What is needed is one that can be operated entirely with the feet."—*Chicago Post.*

The New York State Assembly Committee on Judiciary has reported the bill of Assemblyman Apgar, of Westchester County, which is intended to prevent the reckless operation of automobiles. To reach this end the measure provides that no one shall run an automobile without a license procured from a specified examining board. One dollar is to be charged for an examination and two dollars is added for the issuing of a license, which may be revoked upon satisfactory proof of drunkenness, incompetency or reckless driving of the licensee.

A party of Frenchmen have arrived in New York city with two automobiles which will be shipped to Lake Bennett, in the Klondike, from which point they intend to reach Dawson City by way of Atlin. One of the party is quoted as saying that they expect to make the 112-mile journey from Lake Bennett to Atlin in one day. One of the automobiles is said to be a combination of sleigh and paddle-wheel steamboat. As one of the Frenchmen is the editor of a paper, it would seem that these plans should be taken with a grain of salt and the suspicion of an advertising scheme.

The war has undoubtedly had the effect of promoting the prosperity of the motocar manufacturers, says the *London Court Journal.* It may not seem obvious at first sight, but it is a fact. Six months ago the motocar as applied for business purposes was not being very generally adopted, but since the outbreak of hostilities in South Africa the streets have become comparatively thronged with "autovans." The reason is the tremendous demand for horses for troops at the front. The horses of the omnibus companies, which have been commandeered by the Government, have had to be replaced. The motor vehicles are supplying the want, and it is satisfactory to know that they have been found to be much more economical.

The ELECTRICAL REVIEW is informed on good authority that no less than seven gasoline automobiles, imported from England, are at present detained by the customs authorities at Bombay and not permitted to land or to be used in that city on account of the fact that gasoline volatilizes at the usual temperature of the air in those parts. Consequently, if one started out with a gasoline automobile there he would probably wind up in a coffin, provided any of his anatomy could be found. This action of the authorities will be a considerable blow to the gasoline automobile in India.

A bill introduced in the New York State Legislature by Senator Goodsell provides that a corporation which has operated a stage route in New York or Buffalo for five years last past, may extend its existing routes to any street in the city and operate thereon stages and omnibuses propelled by electricity or other motive power, without securing further consents as required by law, provided such extensions be approved by the State Railroad Commission. Such a company may charge a fare not exceeding 10 cents for a continuous ride over the whole or any part of its route and shall pay the local license fee now required as well as five per cent of its gross receipts. A stage corporation shall not extend its route to a street on which another stage company operates without the consent of the latter.

Mr. John G. Kenedy, proprietor of La Parra ranch, in Texas, recently gave an automobile runabout a test on his ranch. When a bunch of cattle observed Mr. Kenedy on his automobile they stampeded and went through a wire fence. It took the cowboys a long time to round up the cattle and return them to their pasture. Mr. Kenedy then observed that he must teach his cattle to become acquainted with the automobile by degrees. For several days he has been running the vehicle about the place with horses driven immediately in front of it. The cattle are gradually becoming used to it. Two of Mr. Kenedy's cowboys persuaded him to allow them to try their hand at roping a steer from the seat of the vehicle. They were two of the most expert ropers on the ranch and succeeded in landing the rope over a steer's horns. Something happened to the steering and controlling mechanism of the automobile and the vehicle was dragged about the corral by the steer until another cowboy cut the rope.

The Perret Electromobile and Battery.

In 1896 Mr. Frank A. Perret built an automobile to carry five persons, using as a source of motive power the electric storage battery. This vehicle was completed and was operated in a most satisfactory manner, but, in common with nearly all other automobiles of similar carrying capacity and mileage, required a great weight of battery—about 1,200 pounds. This, of course, necessitated the use of very substantial materials in the construction of the vehicle itself, making the total weight considerable. These disadvantages, coupled with the various troubles arising from the best batteries he could obtain and their limitations of output of current, led him to devote his time and energies to the development of certain ideas he had long had in mind. These ideas related to the construction of a type of storage battery which should in itself combine lightness in weight, high rate of charge and discharge, long life and freedom from buckling.

THE PERRET ELECTROMOBILE.

Mr. Perret practically retired from active business life and devoted himself to the task for over three years. His efforts were successful and he developed a type of storage battery which he thinks will undoubtedly play an important part in automobile work. For the present it can only be said that his is an "all lead" and sulphuric acid type of cell, with Plante elements, and that in its manufacture nothing is used to cause chemical or electrical troubles in the course of its natural life. Its capacity is over 14 watt-hours per pound of complete cell (including acid), at a discharge rate of one ampere per pound. This discharge rate may be greatly exceeded without in any way injuring the cell, but, as is the case with all batteries, it is not advisable to prolong high discharges. The charging may be accomplished much more rapidly than is usually the case.

While thousands of laboratory tests and experiments were made by Mr. Perret and his company (The Perret Storage Battery Company), with the most encouraging results, it still remained to make a practical road test of the battery in order to ascertain its real merits as a source of motive power for automobiles. To do this with as little delay as possible, the company decided to build for itself a light vehicle in which should also be included some of Mr. Perret's inventions in these vehicles.

The automobile shown in the illustration is the outcome of this decision. The vehicle complete, with battery, weighs about 440 pounds, but this weight could be reduced in a future similar carriage. It is well and substantially built and, while it is only a one-man vehicle, it will carry with ease a person weighing 250 pounds. The truck is made of steel in the form of two triangles connected in the centre by a horizontal king-bolt to give absolute flexibility to the truck. The reaches terminate at the hubs of the wheels, thereby transmitting all strains in proper directions and eliminating the possibility of breaking of the axles in consequence of any collision. The wheels are 28 inches in diameter and have ball bearings.

This automobile is unique in being operated by a worm gear, which renders it noiseless and makes a very perfect gear for this purpose. This worm gear is of a special design, giving a high efficiency. The motor is suspended on the rear triangle of the truck and is directly coupled to the worm shaft.

Another unique feature of this vehicle is the controller, which is so arranged that speed changes are effected by means of a divided motor field. Several advantages arise from Mr. Perret's method of control, among them being the easily obtained variation of speed, the compactness and positive action of the controller itself and the ability always to discharge all of the cells of the battery in series. No multiple series grouping is necessary and the cells can also be charged in series, without the necessity of making any complicated connections before throwing on the charging circuit. The controller itself is very compact, being only about six inches in diameter and three inches in depth. It is operated in the usual way by a lever which is connected to the controller by a crank carrying an appliance for reversing the polarity of the current. By means of this arrangement, the same set of contacts on the controller are put in use, whether the vehicle is running forward or backward, thus ensuring great simplicity of operation and a minimum of contact points.

The steering is accomplished in the usual manner by pivoted hubs operated by crank levers connected to the steering handle. One hundred and seventy-five pounds of battery is used to operate this automobile, and on one charge this will run it about 40 miles over moderately good roads, at an average speed of 13 miles an hour.

It must be borne in mind that this little vehicle is simply intended to demonstrate Mr. Perret's inventions in the line of the storage battery and the improvements in the automobile itself. It is not expected that this vehicle will itself be a type that will come into extensive use, though there are many who will desire automobiles of this kind for special purposes. What has been demonstrated in this vehicle is the ability to build others of greater carrying capacity which will be less in total weight than many now on the market, and embodying strength, flexibility and simplicity of operation.

A LECTURE ON AUTOMOBILES.

INTERESTING COMPARISONS OF ELECTRIC, GASOLINE AND STEAM VEHICLES.

An interesting lecture on automobiles, accompanied by a practical demonstration of their operation, was given at the Knickerbocker Athletic Club, New York city, on the evening of March 22, by Mr. Hiram Percy Maxim, chief engineer of the Columbia and Electric Vehicle Company, of Hartford, Ct. The original arrangements provided that Mr. Harold H. Eames, vice-president and manager of the Columbia and Electric Vehicle Company, was to deliver the lecture and Mr. Maxim was to make the practical demonstrations, but illness in Mr. Eames's family prevented his presence. Mr. James Joyce, Jr., of the New York Electric Vehicle Transportation Company, made the arrangements for the meeting, which was thoroughly enjoyed by an audience of about six hundred ladies and gentlemen. The lecture was delivered in the club theatre, and an electromobile and a gasoline tricycle were shown in operation on the floor of the club's spacious gymnasium. Mr. Maxim, it will be remembered, was one of two persons who made the record-breaking run in an automobile from Atlantic City to Philadelphia, a distance of 100 miles, without changing automobiles. He is one of the early pioneers in the automobile industry. His address was delivered in a conversational manner which made it all the more enjoyable to the audience.

Mr. Maxim began his remarks by stating that the success of the automobile was largely dependent upon the intelligent cooperation of the public, upon whose good opinion the development of the self-propelled vehicle rests; no one should expect too much of an automobile, nor should one fail to give the vehicle the requisite amount of proper care. The speaker stated that automobile engineers are generally agreed on the fact that there are but three available kinds of power for self-propelled vehicles. These are electricity, gasoline and steam, the only practical sources of power for automobiles that have been developed on any commercial scale. The first commercially successful automobile was the electric vehicle. The limitations of this type are principally its short radius of operation, amounting to about 30 miles, and the comparatively long time required to recharge its storage batteries, the latter being from two to three and a half hours. Its advantages are briefly summed up in the fact that its motor is ideal, its power is stored and may be used in large or small quantities as desired, and the transmitting devices are of the simplest and most easily managed character. The electromobile is the heaviest as well as the most expensive of the three types. In many instances this excess of weight is an advantage, however. Ninety per cent of the skill, care and expense involved in the operation of the electromobile is required at the place where it is stored, while only 10 per cent of skill and care is required in its operation on the road. It is so simple that any one can operate it, which makes it an especially desirable vehicle for ladies and young persons to use. The electromobile is the most expensive of the three types mentioned to operate, but at the same time it is available for any degree of elegance, ornamentation and finish, as well as permitting a wide range of design. Mr. Maxim explained to the audience that the short running radius, 30 miles, meant only 15 miles going and 15 miles coming back, but it was a most satisfactory 30 miles of travel. He stated that the present electromobile is an entirely practical and successful machine commercially and one behind which any manufacturer of intelligence and ability can stand with a reasonable guarantee. The field occupied by the electromobile is very large.

The gasoline automobile has the disadvantage of a reciprocating motor and designers of this type of vehicle have great difficulty in securing a noiseless and smoothly running machine. The motor is not self-starting, extraneous power being required to set the machine going, and where a double cylinder motor is used especial care is required in the operation of the vehicle. Ninety per cent of the skill necessary to operate the gasoline automobile is required on the road, while but ten per cent of the skill is needed in the place where it is stored and charged. This type of vehicle is not nearly so easy of operation as the electromobile. On the other hand a gasoline engine gives more power from a definite quantity of fuel than either of the other types. Properly designed, a gasoline automobile ought to be odorless. This vehicle, in the opinion of the speaker, is peculiarly adapted to that portion of the public at large who like to show their skill and nerve in the operation of a self-propelled vehicle. It is especially adapted for racing and fancy evolutions.

The steam automobile also has the disadvantage of being equipped with a reciprocating motor and yet it is almost as smooth running as the electromobile. A disadvantage is that this type of vehicle requires gasoline to be carried under pressure for fuel, as well as a large quantity of good water. If bad water is used scales form in the boiler tubes and the tubes soon burn out, causing a break-down of the vehicle. Another disadvantage is that a considerable fire must be carried on the vehicle, and the fire burns all the time. The operator, must, consequently, watch the water-gauge and not forget to keep a sufficient quantity of water in the boiler. This feature has led the authorities of many cities to require steam engineer's licenses from the operators of steam automobiles. As with the gasoline vehicle, 90 per cent of the skill involved is required during the running of the machine on the road, while but 10 per cent is necessary in the care of the vehicle. The steam automobile costs a little more per mile of operation than the gasoline vehicle, but its first cost is the cheapest of all. Mr. Maxim gave the following figures as the average first cost of the better makes of vehicles: Steam, $600; gasoline, $1,200; electric, $1,900.

Mr. Maxim cautioned the public against judging the merits of automobiles from a sidewalk inspection, and reminded his hearers that they must not condemn any type of automobile on account of a punctured tire or because the storage batteries were not properly charged, or because the operator forgot to fill the fuel tank. He gave numerous instances of the unjust condemnation of automobiles of all types by persons unfamiliar with them or careless in their operation. The speaker stated that of the three vehicles he believed that the electromobile would develop most rapidly, largely dependent, of course, upon the lessening of weight and the increased capacity of the storage battery.

At the conclusion of the address the audience adjourned to the gymnasium of the club where Mr. Maxim demonstrated practically the speed and easy control of an electromobile runabout of handsome design and unusually small dimensions. He also operated a gasoline tricycle newspaper delivery wagon which, however, made so much noise that the speaker's voice was inaudible while the machine was in operation.

An Electromobile Omnibus.

It is reported that Colonel John Jacob Astor has ordered a large electric omnibus to be used in regular service between Rhinecliff station and Rhinebeck village, where his home is situated. A horse-stage has been in operation for some time, but there has been much dissatisfaction with it; hence, the experiment with the electric omnibus.

Rotary Converters for Charging Automobile Storage Batteries.

A novel and very complete outfit for charging storage batteries has been installed for the New York Electric Vehicle Transportation Company, the current being used for charging the company's numerous automobiles.

This entire apparatus was specially designed and manufactured by the Westinghouse Electric and Manufacturing Company, and illustrates the advantage of having the various elements of a combined set of apparatus harmonize properly. It converts alternating current supplied by a local electric company into direct current for charging storage batteries. Two-phase alternating current of 7,200 alternations, at a voltage of 100 to 110, has to be converted into a direct-current voltage varying from 90 to 140 volts, which is effected by suitable adjustments. The outfit consists of three elements: The rotary converter; two autotransformers, one in each phase, and the switchboard.

The rotary converter transforms alternating into direct current, the ratio of transformation being such as to give a direct-current voltage approximately one and four-tenths (1.4) times the alternating. If the alternating-current voltage is 100, then the direct-current voltage will be 140. In order to obtain a lower direct-current voltage, it is necessary to reduce the voltage of the alternating current by autotransformers. In order to start the rotary satisfactorily a low voltage must be applied; this is also obtained from autotransformers. The rotary converter delivers nominally 110 volts at practically constant electromotive force. The maximum current will be 60 amperes for about half an hour, when the current is gradually diminished to about 10 amperes at the end of about three hours. The rotary is adjustable by means of a field rheostat so that the electromotive force may be reduced from 110 volts to 95 volts. By changing to other loops on the lowering transformers the electromotive force delivered may be changed from 110 to 140 volts. When running at 140 volts the electromotive force may be lowered by means of a rheostat to 125 volts. The rotary is started by throwing a low voltage directly on the armature, and for this purpose suitable loops are provided from the autotransformers. The rotary delivers direct current as a direct-current generator, but at several voltages varying from 110 to 140 volts. The electromotive force is in each case capable of being reduced 15 volts by means of a field rheostat.

The two autotransformers serve three purposes: (a) They reduce the line voltage to a pressure suitable for starting the rotary; (b) They furnish a voltage which, applied to the rotary, gives a direct-current voltage suitable for charging the storage batteries; (c) They introduce into the circuit self-induction of such an amount as permits a variation in the electromotive force of the rotary by a simple adjustment of the rheostat.

The autotransformers have a number of loops so that with either 100 or 110 volts on the primary, the rotary may deliver 105, 110, 115, 120, 130 or 140 volts. The

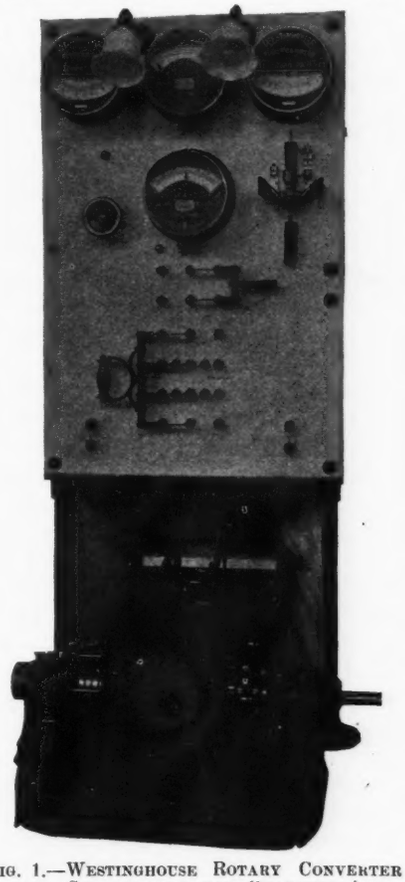


FIG. 1.—WESTINGHOUSE ROTARY CONVERTER AND SWITCHBOARD FOR CHARGING AUTOMOBILE STORAGE BATTERIES.

coil is provided with a number of terminals in the form of binding posts, placed at the transformers to which the

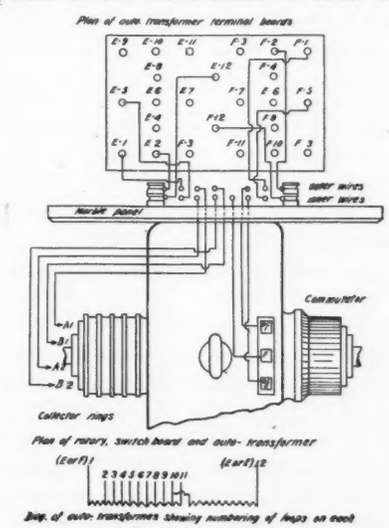

Plan of auto. transformer terminal boards
Commutator
Collector rings
Plan of rotary, switch board and auto- transformer
(Earth)1
(Earth)12
2 3 4 5 6 7 8 9 10 11

FIG. 2.—PLAN OF AUTOTRANSFORMER TERMINAL BOARD.

wires to the switches may be connected. This is to secure certain fixed adjustments, and not to vary the voltage from the autotransformers while the rotary is running.

The switchboard is provided with a double-throw switch for starting and running the rotary, with a double-throw switch for connecting the direct current to the battery, also with a circuit breaker for opening the direct-current circuit in case the current is too great, with ammeters for measuring the alternating current in each phase, with an ammeter for measuring the direct current, and with a voltmeter for measuring the voltage supplied to the battery. Fuses are placed in the alternating-current circuit for opening the circuit in case the current becomes too great. A rheostat enables the voltage applied to the battery to be varied over a small range.

The rotary stands in front of the board, as shown in the illustration, with the autotransformers at the back of the board. In order to start the rotary it is necessary to open the circuit breakers and all switches on the board, and turn the rheostat handle to the right as far as possible, thereby opening the field circuit, and then throw the large four-pole switch to the right. When the rotary has reached synchronism, the rheostat handle is turned to the left, thereby closing the field, and the field strength is adjusted until the alternating-current ammeter registers a minimum, and the large four-pole switch is then quickly thrown to the left, when, if all connections are right, the rotary will run at a synchronous speed.

The rheostat should be adjusted again so that the current indicated by the alternating-current ammeter is a minimum. The direct-current voltage can then be raised or lowered from five to 10 volts by varying the rheostat, which will increase the alternating current. The electromotive force, when the alternating current is a minimum, should be about five volts less than the maximum required for charging the battery.

When the rotary is running and ready for operation, the circuit breaker should first be closed, and then the double-throw direct-current switch should be closed in the direction indicated by the voltmeter. A small load of incandescent lamps should be placed between the binding posts from which the leads are to be taken to the battery. If the direct-current ammeter deflects in the wrong direction, the leads to it should be reversed. All is then in readiness for applying current to the battery. When the battery is charged the circuit breaker is to be opened by hand, the double-throw switch is to be opened together with the four-pole switch, and the rheostat should be moved to its extreme position.

It will be perceived by the illustrations accompanying this article that the outfit forms a complete whole, and all parts harmonize properly. By the arrangement adopted, the incoming wires are carried to the top of the switchboard, and the outgoing wires to the battery, from the side of the board, and the wires to the autotransformers and the rotary are taken from the bottom of the board in the form of flexible cables, all having proper lengths and being adjusted for the terminals to which they are to be connected.

The New York Electrical Society's Automobile Symposium.

The New York Electrical Society held its two hundred and fourth meeting in a lecture room of the College of the City of New York, on the evening of March 22. The entire evening was devoted to a discussion of the status of automobile development as it is to-day and as shown by vehicles propelled by electricity, internal combustion motors and steam motors. The hall was well filled by an appreciative audience who paid close attention to the remarks of the speakers and the illustrations shown on the screen by means of a stereopticon.

Mr. A. L. Riker was the first speaker, his remarks being entitled "The Advantages and Limitations of the Electric Automobile." Mr. Riker spoke entirely of the advantages of electricity as a method of propulsion for automobiles and gave an interesting account of methods of equipment and control for such vehicles. The speaker was introduced by President Gano S. Dunn, who spoke of the great extension of the automobile field and the rapidity of growth of the art which is such as to make books out of date before they appear and to keep the practitioners too busy to write papers.

Mr. Riker began his remarks with reference to the advantages of electricity as a propelling agent for automobiles and spoke of the popular mystery which surrounded the really very simple mechanism and methods employed. "Of all motors," said he, "the electric motor requires the least attention in its operation. It has one feature in common with the old 'hay-motor,' commonly called the horse, which is that both of them exert their greatest tractive effort and power at slow speeds and both of them require no attention on the part of an operator, when they are propelling a vehicle, to make them put forth their best efforts in the ascent of a hill or other situation where these are required. Another feature of similarity and advantage possessed by the electric motor and the horse is over-load capacity. It is the nature of the electric motor, even more than that of the horse, to go ahead and do its best until it destroys itself in the effort to provide sufficient power to meet the conditions it encounters. This is not true of any other variety of propeling agent."

The speaker showed on the screen diagrams of methods of control and spoke of one important point in connection with battery group control methods, which is that a broken connection in the battery generally permits some one combination to remain intact so that the electromobile may be able to return home despite such an accident. He considered the double motor equipment preferable for heavy work on several accounts, one of them being, curiously enough, the prejudice of carriage builders in having wheels slanted outward, which naturally requires a crooked axle and makes it impossible to drive both from one motor. For light vehicles Mr. Riker thought that the single motor equipment is better, since a straight axle can be used across the vehicle and the differential gear placed in one hub so that a maximum of strength and simplicity may be secured with a minimum weight and cost of materials.

Among the numerous types of electromobile vehicles which the speaker illustrated and described was a stage coach intended to carry fourteen passengers. This vehicle, which is now in successful operation, weighs 6,000 pounds and when running at 10 miles per hour on a level macadamized road consumes 3,500 watts. "New types of electromobile omnibus are under construction," said the speaker, "which will carry 20 passengers and which are expected to produce important commercial results in our cities."

Mr. Riker also showed on the screen a very heavy electromobile truck which has been constructed for a firm manufacturing carbonated waters in New York city, and which is in successful operation, delivering loads of 3,000 pounds. This vehicle has a radius of operation of 25 miles on a single charge. A large number of interesting lantern slides accompanied Mr. Riker's remarks, which were greeted at their conclusion with hearty applause.

The next speaker was Mr. C. J. Field, whose address was entitled "The Present Development of the Hydrocarbon or Gasoline Type of Automobile." Mr. Field's remarks began with a simple and lucid description of the present state of the gasoline automobile. He said that until within a very recent period the principal development of this style of automobile had taken place in foreign countries, more particularly in France. This, he stated, was occasioned by the fact that the gas engine and internal combustion motors of all types had been developed to a greater extent in those countries than in the United States, while in America electricity had such a wide and popular field of application that everybody was familiar with it and naturally looked to it as the motive power best suited for automobile propulsion. In his opinion no one type of automobile could meet all the conditions of practice. Each has its place, and it would be gratuitous to say that any one was better than any other or that any one could meet all the requirements demanded of an automobile vehicle. He thought that the gasoline automobile was the middle type as between electricity on the one hand and steam on the other. He felt that the electric vehicle was best fitted for purposes of pleasure and of city travel, but that the gasoline vehicle showed the most adaptation for touring, for commercial trucking and for general pleasure purposes where these involved excursions into the country remote from charging stations; as to the steam engine, he would leave the description of its features to the next speaker.

"Ninety per cent of the trouble," said Mr. Field, "which has been experienced with the gasoline automobile and with the gas engine in any form is due to bad electrical engineering." The weak point of any such engine is generally in the electrical sparking devices, though this form of spark apparatus is preferable to the hot tube or other methods of ignition involving the use of open an flame on the vehicle."

Mr. Field showed a large number of lantern slides giving details of battery motors and vehicles of foreign make and remarked that the average French gasoline automobile looked like a perambulating machine shop. He thought that the American public demanded better looking vehicles than had been produced abroad and that this demand was rapidly being met by manufacturers of automobiles of this class. He concluded his remarks with a brief poem on the disappearance of the horse, which was received with the plaudits of the audience.

The third speaker was Mr. J. A. Kingman, who spoke of the steam carriage. Mr. Kingman showed a number of highly interesting lantern slides representing the earliest types of steam automobiles. As some of these date back into the eighteenth century and were in operation even before the days of the locomotive, they possessed much historical interest. His remarks were confined to a description of these types and of modern types of steam vehicles of which he showed numerous interesting detail views.

After a short period of discussion the meeting adjourned.

The San Francisco Automobile Club has effected a temporary organization by the election of S. D. Rogers, chairman, and B. L. Ryder, secretary. A committee has been appointed to secure suitable quarters for the club.

INDUSTRIAL NOTES

The Automatic Switch Company, Baltimore, Md., are manufacturing a standard line of motor controllers and devices for automatic speed control.

The Electric Appliance Company, Chicago, are exploiting the full line of Dayton fan motors, and are anxious to hear from the trade as to their requirements for the season.

I. P. Frink, 551 Pearl street, New York, informs us that contracts for the installation of Frink reflecting fixtures for electric lighting at the Paris Exposition have been made.

William Roche, 42 Vesey street, New York, informs us that an order has been received by him for 600 of the "New Standard" dry batteries for the Government torpedo station at Newport.

The American Electric Wire Company, 71 West Jackson street, Chicago, has recently been organized to manufacture insulated wires, particularly magnet wires. Mr. W. O. Meissner is president of the company.

The Allen soldering stick, manufactured by the L. B. Allen Company, 1335 Columbia avenue, Chicago, Ill., is noncorrosive, convenient and effective for electrical soldering. This company is also the sole manufacturer of the Allen soldering compounds.

The Harrisburg Foundry and Machine Company, Harrisburg, Pa., is now operating its new plant which has been under construction for some months. This plant is one of the most modern, well-planned and comprehensive manufactories for engine building in America.

The Electric Launch Company, builder of electric launches, passenger boats and yacht tenders, has removed its plant from Morris Heights, New York city, to Avenue A and North street, Bayonne City, N. J., where the company has better facilities of every sort for its purposes.

The St. Joseph Railway, Light, Heat and Power Company, of St. Joseph, Mo., and the Milwaukee Harvester Company, of Milwaukee, Wis., have awarded contracts to the Siegrist Lubricator Company, of St. Louis, Mo., to equip all of their machinery with the Siegrist automatic oiling system.

The American Bicycle Company, Waverly Factory, formerly known as the Indiana Bicycle Company, which has constructed a large number of interesting types of electromobiles, will establish at No. 945 Eighth avenue, New York city, a wareroom, where there will be carried in stock at least five different models of its vehicles for exhibition and as samples.

The Western Electric Company, Chicago, in addition to its large line of conduit for interior wiring, has placed in stock the Greenfield flexible steel conduit. This conduit is easily bent in any direction but is extremely rigid so far as compression is concerned. One of the particular features for which it is adapted is a covering for lamp cord. Flexible lamp cord is inserted in the conduit for use with portable lamps and devices for stage illumination. With this steel covering the flexible cord is entirely protected from abrasion or other mechanical injuries.

The Western Electric Company, Chicago, is sending out to its trade, price lists on electrically heated devices. The following apparatus is carried in stock: Electric curling iron heater, soldering irons, immersion coil heaters, glue pots, smoothing irons, portable stoves or disk heaters, heating pad, electric broiler, griddle-cake cookers, tailors' electric irons and electric radiators.

The Federal Battery Company, of New York city, announces that its "Federal Salts" are now being used by the fire alarm companies all over New York city. The company is also preparing for the War Department a shipment of "Federal Salts" for the Philippine Islands. The demand for this company's goods has been so heavy that it has been compelled to nearly double its working force.

The Michigan Pipe Company, Bay City, Mich., is a large manufacturer of creosoted wood conduits for underground wires which are said to be practically indestructible, and do not gather moisture nor scratch the cables. The company publishes a booklet on the subject of this conduit work which will be found valuable to those who have an interest in this field of engineering work. F. A. Houdletts & Son, 138 Milk street, Boston, Mass., are the eastern representatives for this company.

The American District Steam Company, Lockport, N. Y., is prepared for a very active season in placing the Holly system of carrying steam from electric light and street railway plants for local distribution to other buildings for power and heat. The system is one which is in general use in many of the most important towns and cities and its principle of operation is understood by most engineers. The advantage derived from this system is that it requires no extra fuel, but merely uses the steam which ordinarily is wasted and carries it through mains for further use

The Berlin Iron Bridge Company, of East Berlin, Ct., have increased their capital stock to $750,000, and have made extensive purchases of land at Pittsburgh, Pa., where they will start a branch. They have already placed the orders for the greater portion of their machinery equipment, and are now at work on the plans for the buildings, which will be quite extensive, designed and built by them at their own shops. It is intended that this plant shall be fully equipped with all the modern appliances for doing all classes of steel bridge and structural work; in fact, the layout promises that it will be the best plant of the kind in this country.

It is announced that the Orient Electric Company, of Youngstown, Ohio, has been merged into the Colonial Electric Company, of the same city, and that the two companies will hereafter be run as an individual concern under the name of the latter. An extensive factory at Ravenna, Ohio, is now being completely furnished with modern apparatus for incandescent lamp-making and the manufacture of other electrical apparatus, and the enterprise will be moved from Youngstown to Ravenna. Expert incandescent lamp-makers, electricians and mechanics will be taken to Ravenna and the management will be under the control of Mr. J. B. Estabrook, and Mr. F. E. Kirschner will be superintendent of manufacturing. The new company will be financed by prominent men of Ohio who are practical in the electrical industry.

The United States Motor Vehicle Company, of New York city, has been engaged for the past seven months in carefully developing its electric and gasoline types of vehicles, also the combination type of gasoline and electric. These different types, or models, will be completed during April and ready to show on or before May 1, at which time the company expects to be permanently settled in its factory and ready to go ahead commercially on the business and take orders. This company's vehicles are the result of careful and systematic efforts and designs showing good engineering qualities, and undoubtedly cover a number of novel and carefully developed features which should make them very popular types of vehicles. Its catalogue, circular and other printed matter will be ready on or about May 1, Anybody contemplating purchasing either a gasoline or electric vehicle will do well to communicate with it before selecting.

Among recent contracts secured by the Michigan Electric Company, of Detroit, Mich., is one for an electric sign for Hiram Walker & Sons, of Walkerville, Ont.; Nettleton & Kahn, of Detroit, architects. This sign is to be one of the largest, most elaborate and expensive in the country. It will be 90, or more, feet in length, 60 feet high, and will be supported from the ground on an independent steel frame. This sign will read: "Distillery of Canadian Club, Walkerville," in three rows of letters, and will be fitted with 3,000 or more special Bryan-Marsh sign lamps, mounted in metal illuminated letters, borders, columns and ornamental work, the idea being to have the lettering fitted with clear or frosted lamps and the borders and ornamental trimmings with natural colored lamps. The combination of clear and colored lamps is designed to set off in an artistic manner the lettering and produce in combination the handsomest effect of any sign in the world. The total cost will probably exceed $6,000—this not including the machinery required for operating this sign. The Michigan Electric Company reports being exceedingly busy in its supply business; also in contracting and with the manufacturers' agencies it represents.

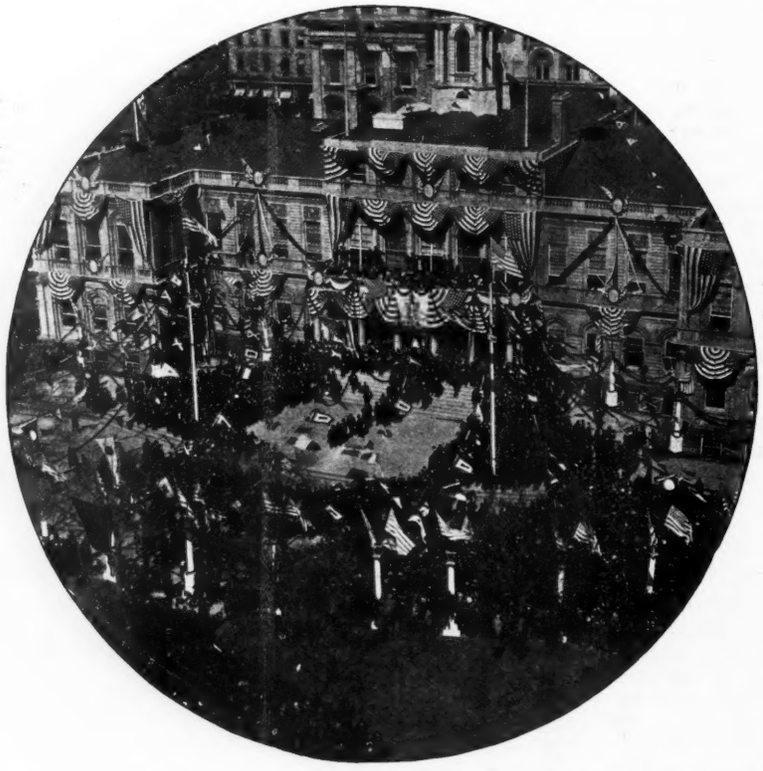
The Formal Beginning of Work on the New York Rapid Transit Railway.

At one o'clock in the afternoon of Saturday, March 24, Mayor Robert A. Van Wyck, of New York city, formally opened the work of constructing the Rapid Transit Railway Tunnel by breaking ground in front of the City Hall in the presence of an enormous crowd of spectators and many officers of the city and Rapid Transit Commission.

The exercises were of a most interesting character, befitting the great importance of the work undertaken. On the plaza in front of the City Hall and at a point which will be on the curve connecting the lower Broadway section of the subway with the Brooklyn Bridge, a portion of the pavement had been removed to make place for a bronze tablet which was set to mark the point at which work was inaugurated. The exercises consisted of addresses by the Mayor, by President Alexander P. Orr, of the Rapid Transit Commission, and Comptroller Bird S. Coler. These gentlemen all spoke of the importance of the great work which was here inaugurated under conditions differing from those usually obtaining, since the tunnel railway will be owned by the municipality and operated by private contractors. They all dwelt upon the vast importance of this public work, which will be the most expensive and elaborate undertaken by this municipality since the construction of the Croton Aqueduct, over fifty years ago.

At the conclusion of these addresses the Mayor, using a silver spade made for the purpose, removed the first spadeful of earth and was followed by President Orr, Vice-President J. H. Starin, Mr. August Belmont and John B. McDonald, the contractor for the work. Many others of the members of the Commission and guests also handled the spade, among them Chief Engineer William B. Parsons. The removal of the first spadeful of earth was marked by cheering on the part of the crowd and the firing of a salvo of artillery. In the excavation made by the various dignitaries was immediately placed a large bronze plate in commemoration of the event. A crowd numbering about 15,000 spectators witnessed the ceremonies. There were also present about 1,000 policemen.

The plaza of the City Hall was decorated gayly with flags and a semi-circular enclosure of white columns marked the space reserved for invited guests and participants in the ceremonies. The accompanying illustration is from a photograph taken from a window in the ELECTRICAL REVIEW offices, overlooking the scene, and gives a better idea than any description could of the decorations and the large gathering in City Hall Park.



PHOTOGRAPH FROM A WINDOW IN THE ELECTRICAL REVIEW OFFICES SHOWING (IN CENTRE) MAYOR VAN WYCK AND OTHER OFFICIALS ABOUT TO BREAK GROUND IN FRONT OF THE CITY HALL FOR THE NEW RAPID TRANSIT UNDERGROUND RAILWAY.

The real work on the construction was begun on the morning of March 26 at several points in Bleecker street, where it is necessary to lower the level of a large main sewer to get it out of the way of the proposed tunnel excavation.

The contracts call for the completion of the tunnel in three years at a cost of $35,000,000. The tunnel will be 109,570 feet long and will extend from end to end of Manhattan Island. There will be 245,000 feet of track underground and in the upper sections of the city 60,000 feet of elevated track. There will be 48 stations, of which five are solely for expresses, and 10 electric station elevators. It is expected that about 10,000 men will be employed on the work and that it will be finished within the time limit, though this involves the utmost exertion on the part of all concerned. The railway will be operated entirely by electricity.

Copper Mining in Vermont.

Work has been begun at the Ely Copper Mines, at Copperfield, Vt., which were recently purchased by George Westinghouse and others, of Pittsburgh. These mines were at one time the second largest copper producing mines in the United States, but through some gross mismanagement in the financial part of the business they went into the hands of a receiver, since which the affairs have been in litigation.

A short time ago permission was granted the receiver to sell the mines.

Contracts have been let for new machinery, the mine is being cleared out, and as soon as weather will permit business will resume its old-time activity.

CONTENTS:

	PAGE
The Electromobile	305
Concerning Electromobile Construction	306
A Record in Export Trade	306
Automobile Stealing	306
Power Consumption and Operative Costs of Automobile Delivery Wagons	307
Electromobiles as Police Auxiliaries	308
Observations on the Automobile	308
American Made Electromobiles for 1900	309
The American Bicycle Company's "Waverley" Electromobiles	309
The "American" Electromobiles	311
No Duty on Automobiles	311
A Horseless Stable in New York City	312
Absorption of the American Bell Telephone Company	312
Electric Storage Battery Company	312
The Electric Vehicle Company's Electromobiles	313
A Storage Battery Decision	314
The Absorption of the Third Avenue Railroad System of New York City by the Metropolitan Street Railway Company	314
Woods Electromobiles	315
The Helios-Upton Company's Storage Batteries	316
Wall Street and the Electrical Stock Market	316
Riker Electromobiles	317
Electric Lighting	318
Electric Railways	318
Telephone and Telegraph	318
The New Repair Department and Charging Station of the New York Electric Vehicle Transportation Company	319
Automobilism in Europe	320
Thresher Electromobiles	321
Views, News and Interviews	322
Electromobile Charging Outfits	322
The Rumford Medal Awarded to Mr. Charles F. Brush	322
Electric Motors for Automobiles	323
An Electromobile Cab Service	323
Automobiles	324
The Perret Electromobile and Battery	325
A Lecture on Automobiles	326
Rotary Converters for Charging Automobile Storage Batteries	327
The New York Electrical Society's Automobile Symposium	328
Industrial Notes	329
The Formal Beginning of Work on the New York Rapid Transit Railway	330
Copper Mining in Vermont	330
Electrical Patents	27

ELECTRICAL PATENTS

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED MARCH 13, 1900.

645,057 Hanger for electric ceiling-fans; W. H. Ayers, West Hoboken, N. J.

645,066 Method of electric welding; R. P. Brown, New York, N. Y.—The method of welding or brazing together flatwise metal pieces, having different characteristics, which consists in holding the pieces together at the seam or joint, and concentrating heat from two external heat sources upon the metals at opposite sides of the joint, the relative thermal intensities at the point of concentration being so proportioned that the metals of the parts shall be brought to their respective welding or brazing temperatures at approximately the same time.

645,088 Electric-motor control; W. W. Hamlen, Johnstown, Pa.

645,089 Apparatus for control of electric motors; W. R. Hamlen, Johnstown, Pa.

645,103 Electric-circuit controller; B. N. Jones, Orange, N. J.—Comprises a movable circuit-controlling contact, an electro-mechanical device to move the same, a brake to cooperate with said contact, an electro-mechanical device to operate said brake, a switch included with the last-named electro-mechanical device in one leg of an electric circuit, a contact for said switch connected directly to the other leg of said circuit, and a second contact for said switch connected to the second leg of said circuit through the first-named electro-mechanical device.

645,116 645,117 Electric-motor control; F. A. Merrick, Johnstown, Pa.—A plurality of electric motors, a controlling-switch having electrically-disconnected groups of contacts and connections arranged in different positions of the switch to connect the motors in series, the armatures in series and the fields in parallel; or the fields in series and the armature in parallel; or the motors as a whole in parallel.

645,125 Alternating-current meter; W. H. Pratt, Lynn, Mass.—An alternating-current meter having a registering device operated by an induction motor, and an auxiliary torque, producing device for overcoming the friction of the parts inductively independent of the primary motor-circuits.

645,126 Electric meter; L. C. Reed, New Orleans, La.—An electric meter comprising a commutator, a starting-coil in a normally-closed circuit through said commutator, a shunt-circuit around said starting-coil, and a contact-brush in said shunt-circuit independently of said closed circuit, and adapted to engage said commutator.

645,127 System of electric metering; L. C. Reed, New Orleans, La.—A plurality of meters, an automatic switch for coupling the same, the said switch comprising a lever, contacts carried thereby, and a solenoid for actuating the lever made up of coils of the positive and negative service-wires wound in opposite directions.

645,128 System of electric metering; L. C. Reed, New Orleans, La.—Consists of a plurality of meters and means actuated by the quantity of current flowing for separately cutting said meters into the circuit.

645,129 System of electric metering; L. C. Reed, New Orleans, La.

645,130 Alternating-current motor; W. G. Rhodes, Salford, England.

Electric Condensers.

WM. MARSHALL, Manufacturer.

STANDARDS A SPECIALTY.

709 Lexington Avenue, - New York.

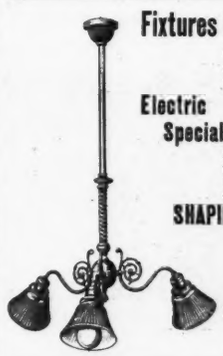
BURNLEY

SOLDERING PASTE.

200 000 ¼-lb. boxes sold in 1898. Universally acknowledged the best. All others are imitations and infringe our Claims. Put up in ¼, ½, 1, 5 and 10-lb. packages.

Burnley Dry Battery Best of All.

BURNLEY BATTERY & MFG. CO., Painesville, Ohio.



Fixtures!!

Gas, Electric and Combination Fixtures.

Electric Specialties,

Such as Clusters, Shade-Holders, Canopies, etc.

SHAPIRO AND ARONSON,

67 Centre St., NEW YORK, N. Y.

Factory, 213-215 Centre St.

ELECTRICAL ENGINEERING TAUGHT BY MAIL.

Thousands are successful and gaining better positions and salaries studying at home by our mail system. We teach Electrical Engineering, Mechanical Engineering, Mechanical Drawing, Machine Design, Electro-Therapeutics. Short Popular Electrical Course, etc., by mail. Study in spare time only. Institute endorsed by Thomas A. Edison and others. Catalogue free.

ELECTRICAL ENGINEER INSTITUTE, Dept. M, 120 Liberty Street, New York.

PATENTS.

Twenty years continuous practice with the Western Union Telegraph Company, American Bell Telephone Company, General Electric Company, Electrical Accumulator Company, Postal Telegraph-Cable Company, and other electrical companies.

Correspondence and interviews solicited.

W. B. VAN SIZE, 253 Broadway, N. Y. Solicitor and Expert.

Electrical House Goods Specialties

ANNUNCIATORS, BATTERIES, CUTOUTS, PUSHES, ETC.

The Electric Gas Lighting Co.

195 Devonshire St., Boston, Mass.

The New System OF EDUCATION Electrical Engineering

Mechanical, Steam Civil and Mining Engineering; Architecture; Drawing; Surveying; Chemistry; Shorthand; Book-keeping and English Branches TAUGHT BY MAIL. Over 50 Courses.

We have helped thousands to better positions and salaries. Send for free circulars, stating the subject in which you are interested.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Box 1002, Scranton, Pa.

Prism.... Globes AND Shades..

GUARANTEED TO GIVE "MAXIMUM LIGHT, COMPLETE DIFFUSION, MINIMUM GLARE," for directing and diffusing ALL KINDS OF LIGHT.....

MANUFACTURED BY THE HOLOPHANE GLASS CO., 1 BROADWAY, NEW YORK, N. Y.

Send for Catalogue and Pamphlets.

"MEN ARE FOUR."

"He who knows not, and knows not he knows not—he is a fool; shun him. He who knows not, and knows he knows not—he is simple; teach him. He who knows, and knows not he knows—he is asleep; wake him. He who knows, and knows he knows—he is wise; follow him."—Arab Proverb.

We know, and we know we know how to build Feed-Water Heaters

Our improved Berryman is a "Little Giant," vastly superior to any other Feed-Water Heater both as to results and durability; 18 years as sellers and manufacturers is the price we paid for our experience.

Try us and you will know, not what you now not know, but what you will then know.

BENJ. F. KELLEY & SON, 91 Liberty St., New York.

We have the largest stock of second-hand Feed-Water Heaters in America, taken in exchange for our improved Berryman.

DISSATISFIED WITH YOUR WAGES?

You can earn more if you learn more. Don't be contented to hold a subordinate position all your life when a few hours' evening study NOW will fit you for a really desirable position and insure better prospects and better wages for life.

STUDY STEAM, ELECTRICAL, MECHANICAL OR MARINE ENGINEERING BY MAIL.

If you are dissatisfied with your position, let us show you how we have helped hundreds of ambitious men to better positions. Write to-day for Handbook "B," giving testimonials and special introductory terms.

AMERICAN SCHOOL OF CORRESPONDENCE. (Chartered by the Commonwealth of Massachusetts.)

Boston, Mass., U. S. A.

IT'S NOT AS WIDE AS A CAMBRIC NEEDLE

yet such a little ribbon of lightning can impair your entire service, unless you are properly protected.

GARTON LIGHTNING ARRESTERS are prominent among the leaders. They have the smallest air-gap, and do not ground your circuit.

Every little storm does not "Knock them out," and their cost is but little compared with the cost of repairs and inconvenience.

GARTON-DANIELS COMPANY, Keokuk, Iowa, - U. S. A.

PLATINUM

IN SHEET OR WIRE, ANY SIZE, SHAPE OR DEGREE OF HARDNESS FOR ALL PURPOSES.

BAKER & CO.,

408-410-412-414 N. J. Railroad Ave., Newark, N. J.

New York Office, 120 Liberty Street.

Scrap and Native Platinum Purchased.

GET OUR NEW CATALOGUE.

BOSTON AGENTS: F. A. HOUDLETTE & SON, 138 Milk Street.

CREOSOTED WOOD CONDUITS

WILL LAST FOREVER. EASILY ACCESSIBLE. FOR UNDERGROUND WIRES. DO NOT GATHER MOISTURE. DO NOT SCRATCH CABLES.

THE MICHIGAN PIPE CO., 998 N. Madison St., BAY CITY, MICH.

A National Rider never changes his mount.—National Cycle Mfg. Co., Bay City, Mich.

FOR SALE.

An electric light plant for sale, with a franchise for 20 years in a good town of 3,000 population. For particulars, address

LEWIS MEAD, Mayor,
Council Grove, Kansas.

FOR SALE.

Electric Light Plant and Grist Mill, both run by water and steam. Electric plan for lighting three villages. One Summer hotel paying $1,200 per year for lights.

Reason for selling is to dissolve partnership.

COLVIN & HOUGHTON,
Manchester Centre, Vt.

WANTED.

A second-hand direct-current **DYNAMO** for 110 volts of sufficient size to carry 250 16-candle-power lamps. Address

LOCK BOX 351,
CAMDEN, N. J.

Wanted

for a large electrical engineering works in England, a designer for large continuous-current railway generators and rotaries. Must have been engaged on this work recently and be fully acquainted with latest practice.

A good opening for a capable engineer or designer who has previously acted in a junior position.

ADDRESS "S. D.,"

at the office of ELECTRICAL REVIEW, New York, detailing recent experience and actual work done.

WANTED

First-class Armature Winders for handwork and machine-formed coils to send for our application blank and register with us. Inexperienced persons need not apply.

BULLOCK ELECTRIC MANUFACTURING CO.
Cincinnati, - - - Ohio

WANTED

A fifty (50) horse-power second-hand engine in good repair, a Westinghouse compound preferred. Advise at once your best cash price.

The Rogers & Hubbard Co.,
Middletown, Conn.

CLOCK CONTACTS

and circuit closers fitted to our famous 60-day clock are perfection for alarms, synchronizers, time switches, program devices and electric clocks.

Send for catalogue No 170.

THE PRENTISS CLOCK IMPROVEMENT CO.,
Dept. 17, 49 DEY STREET, N. Y.

CIRCUIT BREAKERS.

WARD LEONARD ELECTRIC CO.,
Bronxville, N.Y., U.S.A.

Painted Oak Pins & Brackets.

CAR-LOT ORDERS SOLICITED.

PROMPT SHIPMENTS.

KANSAS CITY & SOUTHERN LUMBER COMPANY,
SPRINGFIELD, MO.

POLES · CROSS-ARMS BRACKETS, PINS · TIES

PROMPT SHIPMENT DIRECT FROM MILLS
SAVE BROKERAGES AND SEND US YOUR INQUIRIES

ECCLESTON LUMBER CO.
29 BROADWAY, NEW YORK

SUCCESSFUL ELECTRICIANS

are men of education. Success in the electrical profession is impossible without technical knowledge. You can obtain a thorough electrical education at home during your spare time at a cost so low that you will not notice the outlay. Complete courses by mail in **ELECTRICAL ENGINEERING, Electrical Station Engineering, Electric Railways, Electric Lighting, Telephony, Telegraphy, Electro-Plating, Mechanical Drawing and Dynamo-Electric Machine Design. Best Text-Books Free.** The best, most thorough and practical courses of any correspondence school in the world. Seven years of experience in teaching by correspondence. Write for illustrated circular B, sample pages of text-books, drawing plate and booklet of letters from students all over the world.

THE UNITED CORRESPONDENCE SCHOOLS, 154, 156, 158 FIFTH AVENUE, NEW YORK.
with which are incorporated The Correspondence School of Technology and the Institute for Home Study of Engineering.

H. C. ROBERTS ELECTRIC SUPPLY CO.

331 ARCH ST. PHILADA, PA.
THE BEST GOODS AT FAIR PRICES.

SMALL SPRINGS OF EVERY DESCRIPTION
MADE BY THE WALLACE BARNES CO.
BRISTOL, CONN, U.S.A. ESTABLISHED 1857.

FLAT OR ROUND WIRE, STEEL OR BRASS.
COLD ROLLED STEEL.
KEPT IN STOCK, .003 TO .049 IN THICKNESS.
SPRINGS ENAMELED OR PLATED.
SEND SAMPLES AND WRITE FOR QUOTATIONS.

HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, etc

Non-Magnetic Hair Springs of Phosphor-Bronze and other non-magnetic metals.

Hair Springs of any description manufactured to order.

F. N. MANROSS, Forestville, Conn.

$5 VOLT AMMETER FOR STUDENTS' USE.
(Jewell Bearing and Aluminum Case.)
Adapted to primary and storage battery work.
List of schools using it mailed on application. The method of its use described in a circular just issued.

L. E. KNOTT APPARATUS CO.,
16 Ashburton Place, - BOSTON, MASS.

LIST OF PRACTICAL 10 CENT BOOKS.

No. 1. How to make a Dynamo.
No. 2. How to make a Telephone.
No. 3. How to make an Electric Motor.
No. 4. How to make a Storage Battery.
No. 5. How to make a Wimshurst Electric Machine.
No. 6. How to make a Magneto Machine.
No. 7. How to make a Medical Induction Coil.
No. 8. How to make a Pocket Accumulator
No. 9. How to make a Plunge Battery.
No. 10. How to make a Voltmeter.
No. 11. How to make a Galvanometer.
No. 12. How to make a Hand Dynamo.

These books are illustrated and the price is only 10 cents each, postpaid.

BUBIER PUBLISHING CO.,
Box 709 LYNN, MASS.

Central Manufacturing Co.

Chattanooga, Tenn.
Manufacturers and Dealers in **Yellow Pine, Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets. Large stocks on hand.** Delivered prices quoted, F. O. B. cars, your city, in any quantity.

WRITE US.

THE BRADY MAST-ARMS.

T. H. BRADY, New Britain, Conn., U. S. A.

Manufacturer of Mast-Arms, Pole and Swinging Hoods, House Brackets and other Specialties for Construction Work.—*Catalogues and Prices furnished on application.*

INDIA AND AMBER. **MICA** IN ANY SHAPE OR PATTERN.

EUGENE MUNSELL & CO.,
218 Water Street, New York.
117 Lake Street, Chicago.
WRITE FOR SAMPLES AND PRICES.

McINTIRE'S PATENT
Connectors and Terminals.

Special Connectors for HARD-DRAWN COPPER WIRE, all sizes. FUSED WIRE, FUSED LINKS and STRIPS.

THE C. McINTIRE CO.
13 & 15 FRANKLIN STREET, NEWARK, N. J.

J. G. White & Company,

INCORPORATED.
ENGINEERS, CONTRACTORS
29 Broadway, New York, N. Y.
EQUITABLE BLDG., BALTIMORE.

SHEAFF & JAASTAD,

MECHANICAL and ELECTRICAL ENGINEERS.

Plans and specifications for and superintendence of Electric Power and Lighting Plants a specialty.

85 WATER STREET, BOSTON, MASS.

PATENTS TRADE-MARKS COPYRIGHTS

EDWARD S. DUVALL,
Solicitor of Patents,

Counsellor in Patent Causes.

Some time connected with the late Benjamin Butterworth, before he retired from practice to assume the office of Commissioner of Patents.

Prompt attention given to all matters before the Patent Office, and applications for patents prepared here at Washington from sketches, photos, or models, in a manner to give highest satisfaction and with **less expense** than you will incur elsewhere. Write and convince yourself of this fact. As an attorney at Washington is indispensable you can save the expense of having two by communicating directly with me.

LOAN AND TRUST BUILDING,
WASHINGTON, D. C.